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PHYSICS

KINEMATICS

Kinematics

Kinematics is branch of mechanics which deals with the study of motion of the objects without taking into account the cause of their motion.

Rest and Motion

An object is said to be at rest if it does not change its position which respect to its surroundings with time and said to be in **motion** if it changes its position with respect to its surrounding with time.

- **Rectilinear motion** moving car on horizontal road, motion under gravity etc.
- **Angular motion** such as particle going on a circle, projectile motion, rotation of machine shaft etc.
- **Rotational motion** such as motion of a fan.
- It an object travels equal distances in equal intervals of time, then it is said to be in **uniform motion.**
- It an object travels unequal distances in equal intervals of time, then it is said to be in **non-uniform motion.**

Speed

- The distance covered by a moving body in a unit time interval is called its speed.
- Speed = $\frac{\text{Distance travelled}}{\text{Time taken}}$
- When a body travels equal distances with speed v_1 and v_2, then average speed is the **harmonic mean** of the two speeds.
- $\frac{2}{v} = \frac{1}{v_1} + \frac{1}{v_2} \Rightarrow v = \frac{2v_1v_2}{v_1+v_2}$
- When a body travels for equal times with speeds v_1 and v_2, then average speed is the **arithmetic mean** of the two speeds.
- $v = \frac{v_1+v_2}{2}$

Velocity

- The time rate of change of displacement of a body is called its velocity.
- Velocity = $\frac{\text{Displacement}}{\text{Time}}$
- An object is said to be moving with **uniform velocity** if it undergoes equal displacements in equal intervals of time.
- An object is said to be moving with **non-uniform** or **variable velocity** if it undergoes unequal displacement in equal intervals of time.
- Average velocity = $\frac{\text{Time displacement}}{\text{Total time taken}}$

Acceleration

- The time rate of change of velocity of a body is called its acceleration.
- Acceleration = $\frac{\text{Change in velocity}}{\text{Time taken}}$
- It is a vector quantity and its SI unit is ms^{-2}.
- Acceleration at an instant of time is known as **instantaneous acceleration.**
- When the velocity of a body increases with time, then its acceleration is positive and if velocity decreases with time, then its acceleration is negative called **deceleration or retardation.**
- If acceleration does not change with time, it is said to be **constant acceleration.**

Equations of Uniformly Accelerated Motion (Along straight line)

If a body started its motion with initial velocity u and attains final velocity v in the interval t. The acceleration assumed to be uniform in motion is a and the distance travelled is s, then equations of motion:

- $v = u + at$
- $s = ut + \frac{1}{2}at^2$
- $v^2 = u^2 = 2as$

- If any body is falling freely under gravity, then a is replaced by g in above equations.
- If an object is thrown vertically upward, then in above equations of motion a is replaced by (–g).
- For a body with zero acceleration or constant speed, graph between velocity and time will be a line parallel to time axis.
- For accelerating or decelerating body the graph will be a straight line inclined to time axis and velocity axis.

- Graph between position (distance)-time for an accelerating or decelerating body is always a parabola.
- Acceleration-time graph for uniformly accelerating body is a line parallel to time axis.
- In case of uniform accelerated, the graph between position and velocity is always parabola.
- In case of uniformly accelerated motion, the graph between velocity and time is always a straight line.
- Slope of displacement-time graph gives velocity and slope of velocity-time graph gives acceleration.

Projectile Motion

- When a body is thrown from horizontal making an angle (θ) except 90°, then its motion under gravity is a curved parabolic path, called trajectory and its motion is called projectile motion.
- The motion of a bullet shot from the gun
- The motion of a rocket after burn-out
- The motion of a bomb dropped from a aeroplane etc.

Properties of Projectile Motion

If we drop a ball from a height and at the same time thrown another ball in a horizontal direction, then both the balls would strike the earth simultaneously at different places.

Circular Motion

- The motion of an object along a circular path is called circular motion.
- Circular motion with a constant speed is called **uniform circular motion.**
- The direction of motion at any point in circular motion is given by the tangent to the circle at that point.
- In uniform circular motion, the velocity and acceleration both changes.
- In case of non-uniform circular motion, the speed changes from point to point on the circular track.

Centripetal Acceleration

During circular motion an acceleration acts on the body towards the centre, called centripetal acceleration.
The direction of centripetal acceleration is always towards the centre of the circular path.

Force

It is an external push or pull with can change or tries to change the state of rest or of uniform motion. SI unit is newton (N) and CGS unit is dyne. 1 N = 10^5 dyne.
If sum of all the forces acting on a body is zero, then body is said to be in equilibrium.

Centripetal Force

During circular motion a force always acts on the body towards the centre of the circular path, called centripetal force.

Centrifugal Force

In circular motion we experience that a force is acting on us in opposite to the direction of centripetal force called **centrifugal force.** This is an apparent force or imaginary force and also called a pseudo force.

Applications of centripetal and centrifugal forces

- Cyclist inclined itself from vertical to obtain required centripetal force. To take a safe turn cyclist slower down his speed and moves on a path of larger radius.
- Roads are banked at turns to provide required centripetal force for taking a turn.
- For taking turn on a curved road, the **frictional force** is acting between the tyres of the vehicle and the road acts as centripetal force.
- If a bucket containing water is revolved fast in a vertical plane, the water may not fall even when bucket is completely inverted because a centrifugal force equal or greater than the weight of water pushes the water to the bottom of the bucket.
- For orbital motion of electrons around the nucleus **electrostatic force** of attraction is acting between the electrons and the nucleus as centripetal force.
- Cream is separated from milk when it is rotated in a vessel about the same axis. During rotation lighter particles of cream experience a lesser force than the heavier particles of milk.
- For revolution of the earth around the sun, gravitational force of attraction between the earth and the sun acts as centripetal force.

Newton's Laws

Newton's First Law

A body continues in its state of rest or of uniform motion in a straight line unless an external force acts on it. It is based on **law of inertia**.
Inertia is the property of a body by virtue of which is opposes any change in its state of rest or of uniform motion in a straight line.

Inertia of Rest

- When a bus or train at rest starts, to move suddenly, the passangers sitting in it jerk in backward direction due to their inertia of rest.
- The dust particles come out from a carpet when it is beaten with a stick due to their inertia of rest.
- A passenger jumping out from a rapidly moving bus or train is advised to jump in forward direction and run forward for a short mile due to inertia of rest.

Inertia of Motion

When a running bus or train stops suddenly, the passengers sitting in it jerk in forward direction due to inertia of motion

Momentum

The momentum of a moving body is equal to the product of its mass and its velocity.

Conservation of Linear Momentum

The linear momentum of a system of particles remains conserved if the external force acting on the system is zero.

- Rocket propulsion and engine of jet aeroplane works on principle of conservation of linear momentum. In rocket, ejecting gas exerts a forward force which helps in accelerating the rocket upward.

Newton's Second Law

The rate of change of momentum of a body is directly proportional to the force applied on it and change in momentum takes place in the direction of applied force.

$$F = \frac{\Delta p}{\Delta t} = \frac{m\Delta v}{\Delta t} = ma$$

Newton's Third Law

For every action, there is an equal and opposite reaction and both act on two different objects.

Rocket is propelled by the principle of Newton's third law of motion.

Impulse

- A large force which acts on a body for a very short interval of time and produces a large change in its momentum is called an impulsive force.
- Its unit is newton-second.
- A fielder lowers its hand when catching a cricket ball because by lowering his hands, he increases the time of contact for stopping the ball and therefore fielder has to apply lesser force to stop the ball. The ball will also exert lesser force on the hands of the fielder and the fielder will not get hurt.
- Wagons of a train are provided with the buffers to increase the time of impact during jerks and therefore, decreases the damage. The vehicles like scooter, car, bus, truck etc. are provided with shockers.

Friction

Friction is a force which opposes the relative motion of the two bodies when one body actually moves or tries to move over the surface of another body.

The cause of friction is the strong atomic or molecular forces of attraction acting on the two surfaces at the point of actual contact.

Application of Friction

- A **ball bearing** is a type of rolling-element that uses balls to maintain the separation between the bearing races. The purpose of a ball bearing is to reduce rotational friction and to support loads (weight).
- Friction is necessary for walking, to apply brakes in vehicles, for holding nuts and bolts in a machinery etc.
- Friction can be decreases by polishing the surfaces by using lubricants or by using ball bearings.
- Tyres are made of synthetic rubber because its coefficient or friction with road is larger and therefore, large force of friction acts on it, which stops sliding at turns.
- The tyres are threading which also increases the friction between the tyres and the road.
- When pedal is applied to a bicycle, the force of friction on rear wheel is in forward direction and on front wheel is in the backward direction.

Lever

It is a simple machine in which a straight or inclined rod is made to turn or rotate at a point freely or independently. There are three points related to lever namely load, effort and fulcrum.

- **Load** The weight carried by the lever is called load.
- **Effort** To operate lever, the force applied externally is called effort.
- **Fulcrum** The fixed point about which the rod of lever moves independently is called fulcrum.

OSCILLATIONS AND WAVES

Periodic Motion

- A motion which repeats itself identically after a fixed interval of time, is called a periodic motion.
  For example
  - Motion of arms of a clock, orbital motion of the earth around the sun, motion of a simple pendulum etc.

Oscillatory Motion

- A periodic motion taking place to and fro or back and forth about a fixed point, is called oscillatory motion.
  For example
  - Motion of a simple pendulum.
  - Motion of a loaded spring etc.
- If a particle oscillates with its own natural frequency without help of any external periodic force. The oscillation is then called **damped oscillation.**
- When a body oscillates with the help of an external periodic force with a frequency different from natural frequency of the body, then oscillation is called **forced oscillation.**

Simple Harmonic Motion (SHM)

- An oscillatory motion of constant amplitude and of single frequency under a restoring force whose magnitude is proportional to the displacement and always acts towards mean position, is called **Simple Harmonic Motion.**

Characteristics of SHM

When a particle executing SHM passes through the mean position:

1. No force acts on the particle.
2. Acceleration of the particle is zero.
3. Velocity is maximum.
4. Kinetic energy is maximum.
5. Potential energy is zero.

When a particle executing SHM is at the extreme end, then:

1. Acceleration of the particle is maximum.
2. Restoring force acting on particle is maximum.
3. Velocity of particle is zero.
4. Kinetic energy of particle is zero.

5. Potential energy is maximum.

Simple Pendulum

- A heavy point mass suspended from a rigid support by means of an elastic inextensible string, is called a simple pendulum.
- Time period of a simple pendulum is given by $T = 2\pi\sqrt{\frac{l}{g}}$
- The time period of a simple pendulum of infinite length is 84.6 min. The time period of a second's pendulum is 2 s. Its length on the earth is nearly 100 cm.
- Acceleration due to gravity decreases with altitude (height) and therefore time period of a pendulum clock will increase and clock becomes slow.
- If the bob of a simple pendulum is suspended from a metallic wire, then the length of the pendulum increases with increase in temperature and therefore its time period also increases.
- A girl is swinging over a swing. If she stands up over the swing, then the effective length of the swing decreases and therefore, the time period of oscillations decreases.
- A pendulum clock cannot be used in a space-ship.

Damped Harmonic Motion

- When there is friction or any other force acting within an oscillating system, the amplitudes of the oscillation decreases over time to this damping force. This is called damped harmonic motion.

Resonant Oscillations

- When a body oscillates with its own natural frequency (V_0) with the help of an external periodic force also called forced harmonic motion. And if the frequency (v) provided by the external agent is equal to the natural frequency of the body, the oscillations of the body are called resonant oscillations.

Wave

A wave is a disturbance which propagates energy from one place to the other without the transport of matter.
Waves are broadly of two types:
1. Mechanical Wave
2. Non-mechanical wave

Mechanical Wave: The waves which required material medium (solid, liquid or gas) for their propagation are called mechanical wave or elastic wave. Mechanical waves are of two types.
1. Longitudinal wave: If the particles of the medium vibrate in the direction of propagation of wave, the wave is called longitudinal wave.
2. Transverse Wave: If the particles of the medium vibrate perpendicular to the direction of propagation of wave, the wave is called transverse wave.
Waves on strings under tension, waves on the surface of water are examples of transverse waves.

Non-mechanical waves or electromagnetic waves: The waves which do not require medium for their propagation i.e. which can propagate even through the vacuum are called non mechanical wave.
Light, heat are the examples of non-mechanical wave. In fact all the electromagnetic waves are non-mechanical.
All the electromagnetic wave consists of photon.
The wavelength range of electromagnetic wave is 10^{-14}m to 10^4 m.

Properties of electromagnetic waves
1. They are neutral (uncharged).
2. They propagate as transverse wave.
3. They propagate with the velocity of light.
4. They contains energy and momentum.
5. Their concept was introduced by Maxwell.

Flowing waves are not electromagnetic
1. Cathode rays
2. Canal rays
3. α rays
4. β rays
5. Sound wave
6. Ultrasonic wave

Some Important Electromagnetic Waves

Electro-magnetic Waves	**Discoverer**
γ-Rays	Henry Becqueral
X-Rays	W. Rontgen
Ultra-violet rays	Ritter
Visible radiation	Newton
Infra-red rays	Hershel
Short radio waves or Hertzian Waves	Heinrich Hertz
Long Radio Waves	Marconi

Note: Electromagnetic waves of wavelength range 10^{-3} m to 10^{-2} m are called microwaves.
Phase of vibration: Phase of vibration of a vibrating particle at any instant is the physical quantity which express the position as well as direction of motion of the particle at that instant with respect to its equilibrium (mean) position.

Amplitude: Amplitude is defined as the maximum displacent of the vibrating particle on either side from the equilibrium position.

Wavelength: Wavelength is the distance between any two nearest particle of the medium, vibrating in the same phase. It is denoted by the Greek letter **lambda**. (λ)
In transverse wave distance between two consecutive crests or troughs and in longitudinal wave, distance between two consecutive compressions or rarefactions is equal to wavelength.
Velocity of wave = frequency × wavelength.

Sound

Sound waves are mechanical longitudinal waves and require medium for their propagation. It cannot propagate through vacuum. when propagated speed and wavelength changes but frequency remains constant. It is of three types:
Infrasonic waves – (0 to 20,000 Hz)

Audible waves – (20 to 20,000 Hz)
Ultrasonic waves – (>20,000 Hz)

Properties of Sound Wave

Reflection

- The bouncing back of sound when it strikes a hard surface, is called reflection of sound.
- The laws of reflection of light are also obeyed during reflection of sound.
- The working of megaphone, sound boards and ear trumpet is based on reflection of sound.
- The repetition of sound due to reflection of sound waves, is called an **echo.**
- The persistence of hearing on human ear is $\frac{1}{10}^{th}$ of a second.
- The minimum distance from a sound reflecting surface to hear an echo is nearly is nearly 17 m.
- Sound proof rooms are made of two layers of walls having vacuum between them.
- **Reverberation** arises due to multiple reflection of sound.
- While designing an auditorium for speech or musical concerts, one has to take proper care for the absorption and reflection of sound.
- Time taken by reverberant sound to decrease its intensity by a factor of 10^6 is called **reverberation time.**

Refraction

- When a sound wave move from one mechanical medium to another mechanical medium, it shows deviation from the original path of the incident wave. The phenomenon is called refraction. It is due to difference is speed of sound in media.

Diffraction

- When sound waves originated by a vibrating source, they spread in the medium and if the medium is homogeneous, this leads to bending of sound waves around the edges. Which is known as diffraction.
- The sound waves diffracted broadly and one can easily hears the voice of the another person.

Musical Scale

- In theory of music, a musical scale is a set of musical notes by the frequencies of which are in simple ratios to one another. Sa, re, ga, ma, pa, dha, ni is one such scale called the diatonic scale. The frequencies of these notes are: sa (256), re (288), go (320), ma (341.3), pa (384), dha (426.7) and ni (480). The next note denoted by sa has a frequency 512, twice that of sa. The interval sa-sa is called an octave (8).

Noise Reduction in Recording Media

- Five types of noise reduction system exists in recording media as discussed below
  - Dolby A noise reduction system, intended for use in professional recording studios. It provided about 10 dB of broadband noise reduction.
  - Dolby B was developed to achieve about 9 dB noise reduction primarily for cassettes. It was much simpler than Dolby A and therefore less expensive to implement in consumer products.
  - Dolby C provides about 15 dB noise reduction.
  - Dolby SR (Spectral Recording) system is much more aggressive noise reduction approach than Dolby A. Dolby SR is much more expensive to implement than Dolby B or C, but it is capable of providing upto 25 dB noise reduction in the high frequency range.
  - Dolby S is found on some Hi-Fi and semi-professional recording equipment. It is capable of 10 dB of noise reduction at low frequencies and upto 24 dB of noise reduction at high frequencies.

Doppler's Effect

The apparent change in the frequency of source due to relative motion between the source and observer is called Doppler's effect.

Applications of Doppler's Effect

The measurement of Doppler shift (based on Doppler's effect) has been used

- By police to check over speeding of vehicles.
- At airports to guide the aircraft.
- To study heart and blood flow in different parts of the body.
- By astrophysicist to measure the velocities of planets and stars.

SONAR

- SONAR stands for **Sound Navigation And Ranging.** It is used to measure the depth of a sea, to locate the enemy submarines and shipwrecks.
- The transmitter of a sonar produces pulses of ultrasonic sound waves of frequency of about 50000 Hz. The reflected sound waves are received by the receiver.

Human Ear

- We are able to hear with the help of an extremely sensitive organ of our body called the ear. There are three parts of human ear
  - The **outer ear** is called **pinna**. It collects the sound from the surroundings. The **middle ear** transmits the amplified pressure variations received from the sound wave to the **inner ear**.
- In the inner ear, the pressure variations are turned into electrical signals by the cochlea. These electrical signals are sent to the brain via the auditory nerve and the brain interpret them as sound.

HEAT

Heat

• Heat is the form of energy which produces the sensation of warmth. Its SI unit is joule and other unit calorie (1 cal = 4.2 Joule) .
• The transfer of heat is always from hotter to colder body.

Temperature

• Temperature is measure of hotness or coldness of a body.
• The heat flows from one body to another due to the difference in their body temperature.

Scale of Temperature

• To measure the temperature of a body following temperature scales are used.

— **Celsius scale** of temperature ice point is 0°C Boiling point of water = 100°C

— **Fahrenheit scale** of temperature ice point = 32° F
Boiling point of water = 212° F

— **Kelvin or absolute scale** of temperature ice point = 273° K
Boiling point of water = 373° K

— **Reaumur scale** of temperature ice point is 0° R,
Boiling point of water = 80°R

— **Rankine scale** of temperature ice point
= 491.67°R Boiling point of water
= 671.641° R

Relation between Different Scales of Temperature

Different scales of temperature are related as follows:

$$\frac{C}{100} = \frac{F-32}{180} = \frac{R}{80} = \frac{K-273}{100}$$

K =273+ °C

• At temperature – 40°C = – 40°F

• The temperature at which the three phases of water remains at equilibrium is called triple point of water (273.16 K)

Thermometers

• The instruments used to measure temperature of a body is called thermometer.

Thermometers are of following three types

1. **Clinical thermometer** It is used to measure human body temperatures and ranges from 96° F to 110°F or 35°C to 43°C.

2. **Electronic thermometer** Basic components of an electronic thermometer are thermistors or thermoresistors. Range of electronic thermometer is –40° to 450°F.

3. **Other thermometers** These include constant volume gas thermometer, platinum resistance thermometer etc.

- Clinical thermometer measures temperature in degree fahrenheit (°F).
- In thermometer, mercury is commonly used through a wide range from –30°C to 300°C.
- Thermometer was developed by **Galileo** who found that the gases expand on heating.

Thermal Expansion

- The expansion of a body caused by heat is known as thermal expansion.

Thermal Expansion of Solids

Thermal expansion of solids is of three types

1. Expansion in length on heating, is called **linear expansion**. The increase in length of a rod of unit length of a substance due to increase in its temperature by 1°C is called the **coefficient of linear expansion** of the substance of that rod. It is represented by α.

$$\alpha = \frac{\text{Increase in length}}{\text{Initial length} \times \text{Rise in temperature}} = \frac{\Delta L}{L \times \Delta t}$$

— Its unit is $°C^{-1}$.

2. Expansion in area on heating, is called **superficial expansion**. Coefficient of superficial expansion is given as

$$\beta = \frac{\text{Increase in area}}{\text{Initial area} \times \text{Rise in temperature}} = \frac{\Delta A}{A \times \Delta t}$$

— Its unit is $°C^{-1}$.

3. Expansion in volume on heating, is called **volume expansion** or **cubical expansion**.

Coefficient of volume or cubical expansion is given as

$$\gamma = \frac{\text{Increase in volume}}{\text{Original volume} \times \text{Rise in temperature}} = \frac{\Delta V}{V \times \Delta t}$$

— Its unit is $°C^{-1}$

Relation between Coefficients of Expansions

• Coefficients of thermal expansions are related as
$\beta = 2\alpha$ and $\gamma = 3\alpha$
and $\alpha : \beta : \gamma = 1 : 2 : 3$

• In laying a railway line, a small gap is left in between two iron rails otherwise railway line will become curved on heating in summer.

• Telephone wires are not tighten on poles because in winter, wires get contract and can break.

Thermal Expansion of Liquids

• In liquids, only expansion in volume takes place on heating.

Expansion of liquid is of two types:

• When expansion of the container, containing liquid, on heating, is not taken into account, then observed expansion is called **apparent expansion** of liquids.

• When expansion of the container, containing liquid, on heating, is also taken into account, then observed expansion is called **real expansion** of liquids.

$\gamma_r = \gamma_a + \gamma_g$

where, γ_r and γ_a, are coefficients of real and apparent expansion of liquids and γ_g = coefficient of cubical expansion of the container.

Anomalous Expansion of Water

When temperature of water is increased from 0°C, then its volume decreases up to 4°C, becomes minimum at 4° C and then increases. This behavior of water expansion around 4°C is called, anomalous expansion of water.

Thermal Expansion of Gases

There are two types of coefficient of expansion in gases

— At constant pressure, the change in volume per unit volume per degree celsius, is called **volume coefficient** (γ_v).

— At constant volume, the change in pressure per unit, pressure per degree celsius, is called **pressure coefficient** (γ_p).

Calorimetry

- Amount of heat required to raise the temperature of 1 g of water by 1°C is called 1 calorie.
- Calorimetry states that heat lost by hotter body equals the heat gained by colder body.

Specific Heat

- The amount of heat required to raise the temperature of unit mass (m) of a substance through 1°C, is called its specific heat (s).
- It is denoted by s and its unit is 'cal/g°C or Joule/g°/C.
- The specific heat of water is 4200 J/kg^{1}/°C or 1000 cal/ g^{1}/° C^{-}, which is high compared with most other substances. Therefore, water is used as coolant in radiator in vehicle and hot water is used for the fermentation.
- Heat energy given or taken to change the temperature of a body is given by
  $Q = ms\Delta\theta$
  where, m = mass of the body
  and $\Delta\theta$ = change in temperature.
- The amount of heat required to raise the temperature of 1 mole of a gas by 1°C is called molar specific heat.

Latent Heat

- The heat energy absorbed or released at constant temperature per unit mass for change of state, is called **latent heat**.
- It is denoted by L and its SI unit is cal/g or kcal/kg.
- Heat energy absorbed or released during change of state is given by
  $Q = mL$
  where, m = mass of the substance.
- Latent heat of fusion of ice is 80 cal/g.
- Latent heat of vaporisation of steam is 536 cal/g.

Thermodynamics

- The branch of physics which deals with the study of relation of heat energy with different types of energy is called thermodynamics.

Zeroth Law

- Zerbth law of thermodynamics tells about thermal equilibrium.

First Law

- As per first law about energy, heat given to a substance is equal to sum of change in internal energy and work done.

Second Law

- In second law work can be converted into heat and vice-versa but conversion is not possible with 100% efficience.
- It is impossible for a machine operating in a cyclic process to convert heat completely into work, it is **kelvin's statement**.
- Heat by itself can not transfer from a colder to a hotter body. It is **clausius statement**. Refrigerator is based on this statement.
- **Heat engine** is a device which converts heat into mechanical work. Internal combustion and external combustion heat engine are two types of heat engine.

• Car engine uses coolant added with water to reduce harmful effects like corrosion, rusting etc. Such as ethylene glycol, polossium dichromate etc,

• **Carnot's theorem** tells about maximum efficiency of heat engine. It refers to carnot cycle.

• **Entropy** measures the molecular disorder of a system and is a thermodynamic function depending only on the temperature of the system.

• **Evaporation** is a process in which molecules escape slowly from the surface of a liquid.

- For a given liquid the rate of evaporation demands on the temperature and area of evaporating surface.
- **Refrigerator** is a device used for cooling things by the evaporation and compression of a volatile liquid inside a copper coil.

Humidity

- The presence of moisture in the atmosphere, is called humidity.
- The amount of water vapour present in the unit volume of atmosphere, is called **absolute humidity**.
- The **relative humidity** of air at a given temperature is the ratio of mass of water vapour present in a certain volume of air to the mass of water vapour required to saturate the same volume of air at the same temperature, multiplied by 100.
- Relative humidity is measured by **hygrometer**.
- Relative humidity of about 50% is considered comfortable at temperature 22° – 25° C.
- If the relative humidity is very low in air, then lips become dry and cracks appear in them.
- If relative humidity is very high in air then the sweat from our body does not evaporate readily and therefore we feel uncomfortable.
- **Air conditioning** provides comfortable conditions by regulating temperature and humidity.

Transmission of Heat

- Heat can be transferred from one place to another by process of transmission.
- There are three methods of transmission of heat.

Conduction

- The mode of transmission of heat in solids from higher temperature part to lower temperature part without actual movement of the particles, is called conduction.
- Transmission of heat in solids takes place mainly through conduction.
- Metals are good conductors of heat.
- Wood, cotton, wool, glass are bad conductors of heat, dry air is also a bad conductor of heat.

- Woollen clothes do not allow the heat of our body to escape and therefore we feel warm.
- On a cold night two thin blankets give more warmth than a single thick blanket because the layer of air between the two blankets works as a better insulator.
- Refrigerators and ice-boxes have double walls having thermocol between them which minimise heat gain by conduction.

Convection

- The mode of transmission of heat in fluids (liquids and gases) due to actual movement of the particles, is called convection.
- In liquids and gases, heat is transmitted by convection.
- When a liquid in a vessel is heated at the bottom, the liquid at bottom gets heated and expands.
- Due to its lower density, hot liquid rises and its place is taken by cold liquid from above. Convection currents are set up in the liquid until the temperature of the whole liquid becomes same.
- The cooling unit in a refrigerator is fitted near the top as cold air move downward and keeps cool the whole interior.
- Radiator in a motor car works on the principle of convection.

Newton's Law of Cooling

The rate of loss of heat from a body is directly proportional to the difference in temperatures of the body and its surroundings.

If we take hot water and fresh water and put it in a refrigerator, then rate of cooling of hot water will be faster than the fresh tap-water.

- **Sea Breeze** During day time, the seashore warms up much faster than sea water. Hot air over the seashore rises and cooler air from sea water moves towards seashore to take its place resulting in a sea breeze.
- **Land Breeze** At night, land cools faster than sea water. Now hot air over sea water rises and cooler air from land moves towards sea to take its place and resulting in a land breeze.
- Cloudy night are warmer than clear night because clouds reflect the radiations emitted by the earth at night and keep it warm.

Radiation

- The process of heat transmission in the form of electromagnetic waves, is called radiation.
- Radiation does not require any medium for propagation and it propagates without heating the intervening medium.

Black Body

- A body that absorbs all the radiation incident on it is called perfectly black body.
- Ratio of heat absorbed (radiation) to total incident radiation for a body is called absorptive power (a) of body. It has no unit.
- Amount of heat radiation per unit area of the surface at a given temperature is called emissive power of the surface.
- Its unit is $J/m^2 - s$.
- The ratio of emissive power and absorptive power of a body is always same. It is equal to emissive power of a black body. This is known as **Kirchhoff's law**.
- White colour is a bad absorbers and good reflectors of heat radiations while black colour is good absorbers and bad reflectors of heat. Therefore, clothes of light colours give better feeling in summer and clothes of dark colours give better feeling in winter.

Stefan's Law

- It states that "The amount of heat energy (E) radiated per second by unit area of perfectly black body is directly proportional to the fourth power of absolute temperature (T) of the body."
  $E \propto T^4$
- Good absorbers are good emitters and poor absorbers are poor emitters.

PROPERTIES OF MATTER

Matter

Matter is considered as any thing which has weight and occupy space.

It exist in three states: Solid, liquid and gas.

In solid, molecules vibrate about fixed positions.

In liquid, molecules also vibrate but simultaneously they move freely throughout the material. In gas, the molecules are much farther apart than in solids and liquids and move at high velocities.

Interatomic Forces

The electrostatic force of interaction acting between the two or more atoms is called interatomic forces.

The range of interatomic forces is equal to the order of atomic size, i.e. 10^{-10} m.

A force which changes the configuration of a body, is called a **deforming force.**

Solid

It is that, state of matter which has definite shape and definite volume. In this state molecules are very closely packed.

Properties of Solids

Elasticity

The property of a body by virtue of which it regain its original configuration after the removal of deforming force, is called elasticity.

Quartz and phosphor bronze are almost perfectly elastic bodies.

Plasticity

The property of a body by virtue of which it does not regain its original configuration after the removal of deforming force, is called plasticity.

Strain

The fraction I change in configuration i.e. length, volume and shape, is called strain. Strain has no unit.

On the basis of change in configuration, strain is of three types

- Longitudinal strain = $\frac{\Delta l}{l}$
- Volume strain = $\frac{\Delta V}{V}$
- Shearing strain = θ

Stress

The internal restoring force acting per unit area of cross-section of a deformed body, is called **stress.**

Stress is of two types

- Normal stress
- Tangential stress

The maximum deforming force upto which a body retains its property of elasticity is called the limit of elasticity of the material body.

The minimum stress required to break a wire is called breaking stress.

The torque required to produce a given twist in a hollow cylinder is greater than that required to produce the same twist in a solid cylinder. Therefore, hollow shaft is stronger than a solid shaft.

Springs are made of steel, not of copper as Young's modulus of elasticity of steel is more than that of copper.

Elastic Limit

It is the limit of stress and strain upto which a wire remains elastic.

Plastic Behaviour

If the wire is stretched beyond the elastic limit, the strain increases much more rapidly. If the stretching force is removed, the wire does not comes back to its natural length.

Fracture Point

If the deformation is increased further the plastic behaviour, the wire breaks at a point known as fracture point.

Ductile and Brittle Materials

If large deformation takes place between the elastic limit and the fracture point, the material is called ductile.

If the wire breaks soon after the elastic limit is crossed, it is called **brittle.**

Elastic Fatigue

It is the property of an elastic body by virtue of which its behaviour becomes less elastic under the action of repeated alternating deforming force. Due to elastic fatigue, the bridges becomes less elastic after a use of long time and therefore are declared unsafe.

Fluid

A substance which begins to flow under an external force is called a fluid. Liquids and gases are fluids.

Fluid Density

The ratio of mass to the volume of a body is called its density. (i.e. mass present in its unit volume). It is a scalar quantity having SI unit kg/m^3.

The density of water is 1000 kg/m^3.

The density of water is maximum at 4°C.

Hydrometer It is an instrument used to measure density or relative density of liq . Its working is based on law of floatation.

Fluid Pressure

Thrust (the normal force) exerted by a liquid per unit area of the surface in contact at rest, is called fluid pressure.

Fluid pressure (p) = $\frac{F}{A}$

Its unit is Nm^{-2} or Pascal (Pa).

Atmospheric Pressure

The pressure exerted by the atmosphere, is called atmospheric pressure.

Aneroid barometer is used to measure atmospheric pressure and height of a place.

Other units of atmospheric pressure are torr and bar.

Pascal's Law

The pressure exerted anywhere at a point of confined fluid is transmitted equally and undiminished, in all directions throughout the liquid.

Hydraulic lift, hydraulic press hydraulic brakes works on the basis of Pascal's law.

Buoyancy

When a body is partially or wholly immersed in a liquid, an upward force acts on it, which is called buoyant force or upthrust and this property of fluids is called buoyancy.

Buoyant force is equal to the weight of the liquid displaced by the submerged part of the body.

The buoyant force acts at the centre of gravity of the quid displaced by the submerged part of the body, which is called 'centre of buoyancy'.

Archimedes Principle

When a body is partially or completely immersed in a quid, it loses some of its weight. The loss in weight is equal to the weight of the liquid displaced by the submerged part of the body.

Law of Floatation

A body will float in a liquid if weight of the body is equal weight of the liquid displaced by the immersed part of the body.

In floating condition, the centre of gravity (g) and the centre of buoyancy (B) of the floating body must lie on the same straight line.

Ice and large icebergs float on water surface as its density (0.92 g/cm3) is lesser than the density of water.

When a piece of ice floats on water, its $\left(\frac{11}{12}\right) th$ part submerged in water and (1/12) th part is outside the water.

In sea water, (8/ 9) th part of icebergs is submerged and (1/9) th part is outside the water during floating.

It is easier to swim in sea water than in a river as density of sea water is greater than the density of river water. In sea water, buoyant force is greater than that in river water.

The density of human body is less than the density of water but the density of human head is greater than the density of water. Therefore, during swimming a person displaces the liquid with hands and legs and total weight of displaced liquid becomes equal to the weight of the body.

Surface Tension

The property of a liquid by virtue of which it tries to minimise its free surface area is called surface tension.

The minimum surface area of a given amount of liquid is for spherical shape. Therefore, rain drops are spherical.

Factors Affecting Surface Tension

Temperature The surface tension of a liquid decreases with increase in temperature.

Soluble Impurities If the impurities are less soluble in liquid, then its surface tension decreases. If impurities are highly soluble in liquid, then its surface tension increases.

Applications of Surface Tension

Surface tension of a liquid becomes zero at critical temperature.

When soap, detergent, dettol, phenyl etc., are mixed in water then its surface tension decreases.

When salt is added in water, its surface tension increases.

When oil spreads over the surface of water, its surface tension decreases.

- When kerosene oil is sprinkled on water, its surface tension decreases. As a result the larva of mosquitoes floating on the surface of water die due to sinking.
- Warm soup is tasty because at high temperature its surface tension is low and consequently the soup spreads on all parts of the tongue.
- Antiseptics like dettol have low surface tension and therefore it reaches in the tiny cracks of the wound and cleans the germs and bacteria.
- The surface tension of soap solution in water is less than the surface tension of pure water. Therefore, soap solution cleans greasy strains of clothes better than pure water.

Capillarity

The phenomenon of rising or falling of liquid column in a capillary tube (glass tube of very fine bore) is called capillarity.

Illustrations of capillarity

1. A piece of blotting paper soaks ink because the pores of the blotting paper serve as capillary tubes.
2. The oil in the wick of a lamp rises due to capillary action of threads in the wick.
3. The root hairs of plants draws water from the soil through capillary action.
4. To prevent loss of water due to capillary action, the soil is loosened and split into pieces by the farmers.
5. If a capillary tube is dipped in water in an artificial satellite, water rises up to other end of tube because of its zero apparent weight, how long the tube may be.
6. Action of towel in soaking up water from the body is due to capillary action of cotton in the towel.
7. Melted wax, in a candle rises up to wick by capillary action.

Cohesive and Adhesive Forces

The intermolecular force of attraction acting between the molecules of same substance is called **cohesive force.**

e.g., Intermolecular force of attraction acting between the molecules of water, mercury etc.

The intermolecular force of attraction acting between the molecules of different substance is called **adhesive force.**

e.g., Intermolecular force of attraction acting between the molecules of paper and gum, paper and ink, etc.

Viscous force: The force which opposes the relative motion between different layers of liquid or gases is called viscous force.

Viscosity: Viscosity is the property of a liquid by virtue of which it opposes the relative motion between its different layers.

Viscosity is the property of liquids and gases both.

The viscosity of a liquid is due to cohesive force between its molecules.

The viscosity of a gas is due to diffusion of its molecules from one layer to other layer.

Viscosity of gases is much less than that of liquids. There is no viscosity in solids.

Viscosity of an ideal fluid is zero.

With rise in temperature, viscosity of liquids decreases and that for gases increases.
Viscosity of a fluid is measured by its coefficient of viscosity. Its SI unit is decapoise (kg/ms) or pascal second. It is generally denoted by η.

Stoke's Law
According to this law, the viscous force depends upon the coefficient of viscosity, velocity of the moving object and its size.

Terminal Velocity
When a small spherical body falls through a long liquid column its velocity increases gradually but later on it becomes constant, called terminal velocity.
The radius of spherical rain drops is very small therefore their terminal velocity is also small, with which they strike the earth's surface. When a liquid flow through a pipe, its speed i maximum near axis and minimum near the walls of the pipe.

Equation of Continuity
When a non-viscous liquid flows through a pipe of non-uniform cross-sectional area in stream-lined flow, (i.e. velocity at every point in the fluid remains constant) then at each section of the tube, the product of area of cross-section of the pipe and velocity of liquid remains constant, i.e. A × v = constant.
Therefore speed (v) of fluid flow becomes faster in narrower pipe.

Bernoulli's Theorem
If a non-viscous and incompressible liquid is flowing in stream-lined flow then total energy, i.e., sum of pressure energy, kinetic energy and potential energy, per unit volume of the liquid remains constant.
Venturi tube and aspirator pump works on Bernoulli's theorem.
According to Bernoulli's theorem, with increase in velocity of quid its pressure decreases and vice-versa.
During storms or cyclones, the roofs of the huts or tinned roofs blown off because wind blows with very high speed over the top of the roof and therefore pressure of air decreases. Due to the pressure difference of air above and below the roof, a lifting force acts on the roof. If it is sufficient to balance the weight of the roof it start to fly off.
Magnus Effect : Motion of a Spinning Ball
When swing bowlers deliver the ball, the ball changes its plane of motion in air.

LIGHT

REFLECTION OF LIGHT
(i) The angle of incidence is equal to the angle of reflection
(ii) The incident ray, the normal to the mirror at the point of incidence and the reflected ray, all lie in the same plane

Uses of concave mirrors
Concave mirrors are commonly used in torches, search-lights and vehicles headlights to get powerful parallel beams of light.
They are often used as shaving mirrors to see a larger image of the face. The dentists use concave mirrors to see large images of the teeth of patients.
Large concave mirrors are used to concentrate sunlight to produce heat in solar furnaces.

Uses of convex mirrors
Convex mirrors are commonly used as rear-view (wing) mirrors in vehicles, enabling the driver to see traffic behind him/her to facilitate safe driving. They always give an erect, though diminished, image. Also, they have a wider field of view as they are curved outwards. Thus, convex mirrors enable the driver to view much larger area than would be possible with a plane mirror.

REFRACTION OF LIGHT
when a thick glass slab is placed over some printed matter, the letters appear raised when viewed through the glass slab the bottom of a tank or a pond containing water appears to be raised seen a pencil partly immersed in water in a glass tumbler. It appears to be displaced at the interface of air and water
A lemon kept in water in a glass tumbler appears to be bigger than its actual size, when viewed from the sides.

The following are the laws of refraction of light.
(i) The incident ray, the refracted ray and the normal to the interface of two transparent media at the point of incidence, all lie in the same plane.
(ii) The ratio of sine of angle of incidence to the sine of angle of refraction is a constant, for the light of a given colour and for the given pair of media. This law is also known as Snell's law of refraction.
If i is the angle of incidence and r is the angle of refraction, then,
Sin i/Sin r = constant

The one with the larger refractive index is optically denser medium than the other. The other medium of lower refractive index is optically rarer. The speed of light is higher in a rarer medium than a denser medium
The light from the Sun constitutes parallel rays of light. These rays were converged by the lens at the sharp bright spot formed on the paper. In fact, the bright spot you got on the paper is a real image of the Sun. The concentration of the sunlight at a point generated heat. This caused the paper to burn.

REFRACTION OF LIGHT THROUGH A PRISM
DISPERSION OF WHITE LIGHT BY A GLASS PRISM

The prism has probably split the incident white light into a band of colours. the sequence of coloursVIBGYOR . The

splitting of light into its component colours is called dispersion.

Different colours of light bend through different angles with respect to the incident ray, as they pass through a prism. The red light bends the least while the violet the most. Thus the rays of each colour emerge along different paths and thus become distinct.It is the band of distinct colours that we see in a spectrum.

A rainbow is a natural spectrum appearing in the sky after a rain shower (Fig. 11.7). It is caused by dispersion of sunlight by tiny water droplets, present in the atmosphere. A rainbow is always formed in a direction opposite to that of the Sun. The water droplets act like small prisms. They refract and disperse the incident sunlight, then reflect it internally, and finally refract it again when it comes out of the raindrop Due to the dispersion of light and internal reflection, different colours reach the observer's eye.

ATMOSPHERIC REFRACTION
The air just above the fire becomes hotter than the air further up. The hotter air is lighter (less dense) than the cooler air above it, and has a refractive index slightly less than that of the cooler air.Since the physical conditions of the refracting medium (air) are not stationary, the apparent position of the object, as seen through the hot air, fluctuate. This wavering is thus an effect of atmospheric refraction (refraction of light by the earth's atmosphere) .

Twinkling of stars
The twinkling of a star is due to atmospheric refraction of starlight.
The starlight, on entering the earth's atmosphere, undergoes refraction continuously before it reaches the earth. The atmospheric refraction occurs in a medium of gradually changing refractive index. Since the atmosphere bends starlight towards the normal, the apparent position of the star is slightly different from its actual position. As the path of rays of light coming from the star goes on varying slightly, thestarlight entering the eye flickers – the star sometimes appears brighter, and at some other time, fainter, which is the twinkling effect.

Advance sunrise and delayed sunset

The Sun is visible to us about 2 minutes before the actual sunrise, and about 2 minutes after the actual sunset because of atmospheric refraction. The time difference between actual sunset and the apparent sunset is about 2 minutes.

SCATTERING OF LIGHT
The blue colour of the sky, colourcolour of water in deep sea, the reddening of the sun at sunrise and the sunset.

Why is the colour of the clear Sky Blue?
The red light has a wavelength about 1.8 times greater than blue light. Thus, when sunlight passes through the atmosphere, the fine particles in air scatter the blue colour (shorter wavelengths) more strongly than red. The scattered blue light enters our eyes. If the earth had no atmosphere, there would not have been any scattering. Then, the sky would have looked dark. The sky appears dark to passengers flying at very high altitudes, as scattering is not prominent at such heights.

Total Internal Reflection
a)mirage
Hotter air is less dense, and has smaller refractive index than the cooler air. On hot summer days, the air near the ground becomes hotter than the air at higher levels noticed that while moving in a bus or a car during a hot summer day, a distant patch of road, especially on a highway, appears to be wet. This is also due to mirage.
b) Diamonds - Their brilliance is mainly due to the total internal reflection of light inside them.
c) Optical fibres too make use of the phenomenon of total internal reflection.Light undergoes repeated total internal reflections along the length of the fibre there is no appreciable loss in the intensity of the light signal.

Tyndall Effect
The earth's atmosphere is a heterogeneous mixture of minute particles like smoke, tiny water droplets, suspended particles of dust and molecules of air.When a beam of light strikes such fine particles, the path of the beam becomes visible.

when a fine beam of sunlight enters a smoke-filled room through a small hole. Tyndall effect can also be observed when sunlight passes through a canopy of a dense forest.

The colour of the scattered light depends on the size of the scattering particles. Very fine particles scatter mainly blue light while particles of larger size scatter light of longer wavelengths.

MAGNETISM AND ELECTRICITY

Electricity

- The electricity produced by friction between two appropriate bodies, is called static electricity, it is also called **frictional electricity.**
- The electrostatic force of interaction acting between two stationary point charges is directly proportional to the product of magnitude of charges and inversely proportional to the square of the distance between them.

Electric Field

- The space in the surrounding of any charge in which its influence can be experience by other charge, is called electric field.

- **Electric field intensity (E)** at any point is defined as the electrostatic force **(F)** acting per unit positive test charge (q) at the point.
- $\boldsymbol{E = \frac{F}{q}}$
- Its unit is newton/coulomb.
- Therefore, electric field intensity is inversely proportional to the square of the distance r from the point charge.

Electric Field Lines

- An **electric field line** is an imaginary line, so that its tangent at any point is in the direction of the electric field vector at that point.
- Two lines can never intersect. Electric field lines always begin on a positive charge and end on a negative charge and do not start or stop in mid-space.

Electric Potential

- **Electric potential** at a point in an electric field is equal to the work done per unit charge in carrying a test charge from infinity to that point. Its unit is joule/coulomb.
- Electric potential, V = $\frac{W}{q}$.
- Potential difference is that physical quantity which decides the direction of flow of charge between two points in electric field.
- Positive charge always tends to move from higher potential towards lower potential.

Electric Dipole and Capacitor

- An **electric dipole** consists of two equal and opposite point charges separated by a very small distance.
- **Electric dipole moment** of the dipole is product of charge and the separation between the charges.
- A **capacitor or condenser** is a device over which a large amount of charge can be stored without changing its dimensions.
- The **capacitance** of a conductor is equal to the ratio of the charge (q) given to the conductor to change in its potential (V) is given by C = $\frac{q}{V}$
- Its unit is coulomb/volt or farad. Farad (F) is a large unit of capacitance. Its practical unit is microfarad (μF).
- $1\mu F = 10^{-6}F$

Type of Materials

- **Conductors** are those type of materials which have number of free electrons to conduct the electricity. The metals are good conductors of electricity.
- **Insulators** are that type of materials which do not have the free electrons in its volume and hence, it does not conduct the electricity at all.
- **Semiconductor** is that type of materials which do not have free electrons at the normal temperature, but has the free electrons at the increased temperature and hence, behaves like a conductor. The materials such as silicon, germanium etc., are the semiconductor.

Electric Current

- An electric current whose magnitude and direction do not change with time is called direct current, and whose magnitude changes continuously and direction changes periodically is called alternating current.
- Inverter is a device which converts DC to AC.
- In solid conductors, electric current flows due to flow of electrons, in liquids due to flow of ions as well as electrons and in semiconductors due to flow of electrons and holes.

Conductance

- **Conductance and conductivity** is the reciprocal of resistance and the resistivity of the material respectively. The SI unit of conductance is Ω^{-1} i.e., mho and to that of conductivity is $\Omega^{-1}m^{-1}$.

Resistivity

- Resistivity of a material depends on the temperature and nature of the material depends on temperature and nature of the material. It is independent of dimensions of the conductor, i.e., length, area of cross-section etc.
- Resistivity of metals increases with increase in temperature.

Combination of Resistances

- It resistance R_1, R_2 and R_3 are connected in **series,** then their equivalent resistance is given by $R = R_1 + R_2 + R_3$
- In series combination, equal current flows through each resistors.
- If resistances R_1, R_2, R_3 are connected in **parallel**, then their equivalent resistance is given by
- $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$
- In parallel combination, potential difference across each resistor remains same.

Ohm's law

- It states that if physical conditions of any conductor such as temperature, pressure etc., remain unchanged, then electric current (I) flowing through it is directly proportional to the potential difference (V) applied across its ends, i.e.,
- $I \propto V$ or $V = IR$
- where, R is the electrical resistance of the conductor.

Electric Cell

- An electric cell is a device which converts chemical energy into electrical energy.
- Electric cell are of two types
- —**Primary cell** cannot be charged. Voltaic, Daniell and Leclanche cells are primary cells.
- —**Secondary cell** can be charged again and again. Acid and alkali accumulators are secondary cells.

- Working of electric cells is based on chemical effect of electric current.

Emf of a Cell

- The work done by the cell to bring a (+)ve charge from its own terminal to the other is known as its emf (electromotive force). Electromotive force is work but not a force.

Joule's Law of Heating

- Current can produce three effects : heating effect, magnetic effect and chemical effect.
- Heat is produced in conductor in time t is given by
- $H = Vlt = I^2R = \frac{V^2t}{R}$
- This is known as **Joule's law of heating.**
- Electric bulb, electric kettle, heater etc., devices work on e basis of heating effect of electric current.
- To protect the domestic appliances from sudden change in electricity, fuses are used. It is made of tin, lead, alloy (63% + 37%).
- It should have high resistance and low melting point always connected in series.

Electric power

- The electrical energy produced or consumed per unit time is called electric power.
- Electric power, P = VI = $I^2R = \frac{V^2}{R}$
- 1 kWh = 3.6×10^6 J

Chemical Effect of Electric Current

- When an electric current is passed through an acidic or basic solution, it decomposes into its positive and negative ions. The positive ions collect at negative electrode (cathode) and the negative ions collect at positive electrode (anode).
- This phenomenon is called electrolysis. It is chemical effect of current. The process of coating of a base metal with a layer of more expensive metal, is called **electroplating**.

Domestic Electrification

- From the distribution, the two terminals are supplied to the houses named as live and neutral (neutral is earthed at local substation). The third terminal is introduced as the earth for the safety in the building.

Lightning Appliance

- The electric discharge occurring between two charged clouds or between a charged cloud and earth can damage the houses or buildings. To protect this lightning conductors are used.

Magnetism

- **Magnet**
- A magnet is a material which can attract iron objects.
- A natural magnet is an ore of iron (Fe_3O_4) called magnetite or lodestone.
- A magnet which is prepared artificially, is called an **artificial magnet**.
- A freely suspended magnet always aligns itself into North-South direction. Like magnetic poles repel and unlike magnetic poles attract each other.
- A current-carrying coil containing a soft iron core, is called an **electromagnet.**
- An electromagnet is utilised in electric bell, telegraph receiver, telephone diaphragm, transformer, dynamo etc.
- Permanent magnets are made of steel and temporary magnet or electromagnets are made of soft iron because steel cannot magnetised easily but when it is magnetised one time, cannot be demagnetised easily. The soft iron can be magnetised or demagnetised easily.

Properties of Magnet

- **Attractive property** A magnet can attract small pieces of magnetic substances like iron, steel, cobalt, nickel etc. The attraction is maximum at poles. Unlike poles attract and like poles repel.
- **Directive property** A magnet, when suspended freely, aligns itself approximately along geographical N-S line.
- **Magnetic poles exist in pairs** If a magnet is cut into two equal parts transverse to its length, then N and S-poles of the magnet do not get separated.

Magnetic Field

- The space in the surrounding of a magnet or a current carrying conductor in which its magnetic effect can be experienced, is called magnetic field.
- **Magnetic lines of force** is an imaginary line drawn in magnetic field at which a magnetic North pole will move, if it is free to do so.
- A tangent drawn at any point of an magnetic line of force represents the direction of magnetic field at that point.
- The **magnetic flux** linked with a surface is equal to the total number of magnetic lines of force passing through that surface normally. Its unit is weber.

Earth's Magnetism

- The earth has its own magnetic field. The pole near the geographic North of the earth is called the magnetic North pole. Similarly, the pole near the geographic South pole is called the magnetic South pole.
- The Earth's magnetic field diverts charged particle coming m space towards its poles and saves living beings from being severely harmed.
- **Magnetic compass** A magnetic needle which always direct in North-South (N-S) direction.

Magnetic storm

- Local disturbances in the earth's magnetic field which can damage telecommunication which are probably

caused by lump of charged particles emanating from the sun is known as magnetic storm.

Moving Coil Galvanometer

- A moving coil galvanometer is used to detect the presence of current and the direction of current in any circuit.

Ammeter and Voltmeter

- An ammeter is an instrument used to measure electric current. It is always connected in series. The resistance of an ideal ammeter is zero.
- A **galvanometer** can be converted into an ammeter by connecting a low resistance in parallel.
- A voltmeter is a device used to measure potential difference between two points in an electric circuit.
- The resistance of an ideal voltmeter is infinity. It is always connected in parallel.
- A galvanometer can be converted into a voltmeter by connecting a high resistance in series.
- A small resistance connected in parallel with the load resistance to reduce amount of electric current through resistor is called shunt.

Magnetic Substances

- There are three types of magnetic substances Paramagnetic, Diamagnetic and Ferromagnetic.
- **Paramagnetic Substances**
- Those substances which are feebly magnetised in the direction of magnetic field when placed in strong magnetic field, are called **paramagnetic substances.**
- For examples—Aluminium, platinum, chromium, manganese, solutions of salts of iron, nickel, oxygen etc.
- These substances are attracted towards strong magnetic field in a non-uniform magnetic field.
- The magnetism of these substances decreases with increase in temperature.

Diamagnetic Substances

- Those substances which are feebly magnetised in the opposite direction of magnetic field when placed in strong magnetic field are called diamagnetic substances.
- For examples— Gold, silver, zinc, copper, mercury, water, alcohol, air, hydrogen etc.
- These substances are attracted towards weak magnetic field in a non-uniform magnetic field.
- The magnetism produced in these substances does not change with increase or decrease in temperature.

Ferromagnetic Substances

- Those substances which are strongly magnetised in the direction of magnetic field when placed in it, are called ferromagnetic substances.
- For examples —Iron, nickel, cobalt etc.
- The magnetism produced in these substances decreases with increase in temperature and at a particular temperature, called Curie temperature.
- At the **Curie temperature**, a paramagnetic substance becomes diamagnetic.
- Curie temperature for iron is 770°C and for nickel is 358°C.

Electromagnetic Induction (EMI)

- Whenever the magnetic flux linked with an electric circuit changes, an emf is induced in the circuit. This phenomenon is called electromagnetic induction.

Faraday's Laws of EMI

- Whenever the magnetic flux linked with a circuit changes, an induced emf is produced in it.
- The induced emf loses as long as the change in magnetic flux continues.

Lenz's Law

- The direction of induced emf or induced current is always in such a way that it opposes the cause due to which it is produced.

Eddy Current

- If a piece of metal is placed in a varying magnetic field or rotated with high speed in a uniform magnetic field, then induced current set up in the piece is like whirlpool of air, called eddy current, also known as **foucault's current.**

Uses

- Eddy currents are used in dead beat galvanometer, induction furnaces, induction motor, speedometers of automobiles etc.
- Eddy currents are used in diathermy for deep heat treatment of the human body.

Self and Mutual Induction

- The phenomenon of production of induced emf in a circuit due to change in current flowing in its own, is called **self induction.**
- The unit of self induction is Henry (H).
- The phenomenon of production of induced emf in a circuit due to change in magnetic flux in its neighbouring circuit, is called **mutual induction.**
- Its unit is Henry (H).

Alternating Current

- An electric current whose magnitude and direction changes continuously is called alternating current.
- The frequency of alternating current in India is 50 Hz.

Mean or average value of AC is zero for one complete cycle.

- **Root mean square value** of AC is given by
- $I_{rms} = \frac{I_0}{\sqrt{2}}$
- An AC ammeter and AC voltmeter read root mean square value of alternating current and alternating voltage respectively.

AC Generator or Dynamo

- It is a device which Inverts mechanical energy into alternating current.
- Its working is based on electromagnetic induction.

DC Motor

- It is a device which converts electrical energy into mechanical energy.
- Its working is based on the fact that when a current carrying coil is placed in uniform magnetic field, a torque acts on it.

Transformer

- It is a device which can change a low voltage current into a high voltage current and vice-versa.
- Its working is based on mutual induction.

Step-up Transformer

- It converts a low voltage current into a high voltage current.
- The main energy losses in a transformer are given below
- —Iron loss —Flux loss
- —Hysteresis loss —Humming loss (ohmic loss)

NUCLEAR REACTOR

A nuclear reactor is a system that contains and controls sustained nuclear chain reactions.In nuclear reactors, the nuclear fission is controlled by controlling the number of neutrons released during the fission.The energy liberated in a controlled manner is used to produce steam, which can run turbines and produce electricity.

Fuel - (uranium 235 , Plutonium-239)
The fissionable material is used in the reactor along with a small neutron source.The solid fuel is made into rods and is called fuel rods.

Role of extra neutron -
These neutrons in turn can initiate fission processes, producing still more neutrons, and so on. This starts a chain reaction. Slow neutrons (thermal neutrons) are much more likely to cause fission in 235 92 U than fast neutrons. Fast neutrons liberated in fission would escape instead of causing another fission reaction.
If the chain reaction is uncontrolled, it leads to explosive energy output, as in a nuclear bomb or Atom bomb. Each time an atom splits, it releases large amounts of energy in the form of heat.

Moderators -(water, heavy water (D2O) and graphite)
Light nuclei called moderators are provided along with the fissionable nuclei for slowing down fast neutrons.

Core - The core of the reactor is the site of nuclearfission. It contains the fuel elements in suitably fabricated form.

Reflector-The core is surrounded by a reflector to reduce leakage. The energy (heat) released in fission is continuously removed by a suitable coolant.

Coolant - (water, heavy-water, liquid sodium, helium,Liquid oxygen)
The coolant transfers heat produced during fission to a working fluid which in turn may produce stream. The steam drives turbines and generates electricity.

Control rods- (cadmium,Boron)
The reactor can be shut down by means of rods (made of, for example, cadmium,Boron) that have high absorption of neutrons.cadmium and boron can absorb neutrons to form the corresponding isotopes, which are not radioactive.

Shield - The whole assembly is shielded with heavy steel or concrete to check harmful radiation from coming out.

WORK, POWER AND ENERGY

Work, Energy and Power

Work
Work is a scalar quantity. Its SI unit is joule and CGS unit is erg. 1 joule = 10^7 erg.
Work done by a force is zero when
-Body is not displace actually, i.e. s = 0
-Body is displaced perpendicular to the direction of force i.e. $\theta = 90°$.

Work done by a variable force

If we throw a ball upward, work done against gravity is given by, W = mgh
where, m = mass of the body,
g = acceleration due to gravity and
h = height through which the ball is raised.

The centripetal force acts on a body perpendicular to the direction of motion. Therefore, work done by or against centripetal force in circular motion is zero.
If a coolie is carrying a load on his head and moving on a horizontal platform, then work done by force of gravity is zero as displacement is perpendicular to the direction of force of gravity.

Energy

Energy of a body is its capacity of doing work. It is a scalar quantity and its SI unit is joule.
Energy can be transformed into work and vice-versa with the help of some mechanical device.
There are two types of Mechanical Energy, which are as follows

Kinetic Energy

The energy possessed by a body by virtue of its motion is called its kinetic energy.
Kinetic energy of the body of mass m moving with velocity v is given by K = $\frac{1}{2}mv^2$

Potential Energy
The energy possessed by any object by virtue of its position or configuration is called its potential-energy.
Gravitational potential energy, U = mgh

Einstein's Mass-Energy Relation
According to this relation, the mass can be transformed into energy and vice-versa.
When Δm mass is disappeared, then produced energy
E= Δmc^2
where, c = speed of light in vacuum.

Conservative and Non-conservative forces
Conservative forces are non-dissipative forces like gravitational force, electrostatic force etc.
For the conservative forces, work done during a round trip is always zero.
Non-conservative forces are dissipative in nature like frictional force, viscous force etc.

Law of Conservation of Energy
Energy can neither be created nor be destroyed, only one type of energy can be transformed into other form of energy.
Only for conservative forces, (total mechanical energy) initially = (total mechanical energy) finally

Some Equipments used to Transform Energy

S.	Equipment	Energy Transformed
1.	Dynamo	Mechanical energy into electrical energy
2.	Candle	Chemical energy into light and heat energy.
3.	Microphone	Sound energy into electrical energy.
4.	Loud Speaker	Electrical energy into sound energy.
5.	Solar Cell	Solar energy into electrical energy.
6.	Tube light	Electrical energy into light energy.
7.	Electric Bulb	Electrical energy into light and heat energy.
8.	Battery	Chemical energy into electrical energy.
9.	Electric motor	Electrical energy into mechanical energy.
10.	Sitar	Mechanical energy into sound energy.

Collision
Collision between two or more particles is the interaction for a very short interval of time in which they apply relatively strong forces on each other. For a collision, physical contact of two bodies is not necessary.

A collision in which momentum of the system as well as kinetic energy of the system remains conserved, is called an elastic collision. In an elastic collision, all involved forces are conservative forces.

A collision in which only momentum remains conserved but kinetic energy of the system does not remain conserved, is called an **inelastic collision.**

If after collision two colliding bodies gets sticked with each other and moves with a common velocity, then collision is said to be **perfectly inelastic**.
In perfectly inelastic collision, the loss of kinetic energy during collision do not recover at all and two bodies stick together after collision.

Gravitation
Each and every massive body attracts each other by virtue of their masses. This phenomenon is called gravitation.

Newton's Law of Gravitation
The gravitational force acting between two point objects is directly proportional to the product of their masses and inversely proportional to the square of the distance between them.
Gravitational force (F) = $\frac{Gm_1m_2}{r^2}$
where, G is universal gravitational constant.
Its value is $6.67 \times 10^{-11}\ N-m^2\ kg^{-2}$.
Gravitational force is a central as well as conservative force.

Acceleration Due to Gravity of Earth
The uniform acceleration produced in a freely falling body due to the earth's gravitational pull, is called acceleration due to gravity, g = $\frac{GM}{R^2}$
where, M = mass of the earth, R = radius of the earth.
The value of g changes slightly from place to place but its value near the earth's surface is 9.8 ms^{-2}.
Gravitational force is the weakest force in nature. It is 10^{36} times smaller than electrostatic force and 10^{38} times smaller than nuclear force.

Factors Affecting Acceleration due to Gravity

Shape of Earth Earth is not completely spherical its radius at equator is approximately 42 km greater than its radius at poles.

The value of g is maximum at poles and minimum at equator.

There is no effect of rotation of the earth at poles and maximum at equator.

Effect of Altitude Therefore, g decreases with altitude.

Effect of Depth g decreases with depth and becomes zero at centre of the earth.

Mass and Weight

The mass of a body is the quantity of matter contained in it. It is a scalar quantity and its SI unit is kg.

Mass is measured by an ordinary equal arm balance.

Mass of a body does not change from place to place and remains constant.

The weight of a body is the force with which it is attracted towards the centre of the earth. Weight of a body (w) = mg

The centre of gravity of a body is that point at which the whole weight of the body appears to act.

The centre of gravity of a body can be inside the material of the body or outside it.

It is a vector quantity and its SI unit is newton (N). It is measured by a spring balance.

Weight of a body is not constant, it changes from place to place.

Weight of a Body in a Lift

When lift is rest or in uniform motion The weight recorded in spring balance (i.e. apparent weight) is equal to the real weight of the body w = mg.

When lift is accelerating upward The weight recorded in spring balance is greater than then real weight of the body w' = m(g + a)

When lift is accelerating downward The weight recorded in spring balance is greater than the real weight of the body w' = m(g – a).

When lift is falling freely under gravity The apparent weight of the body

w' = m (g – g) (∵ a = g)

w' = 0

Therefore, body will experiences weightlessness.

Weight of a Body at the Moon

As mass and radius of moon is lesser than the earth, so the force of gravity at the moon is also less than that of the earth. It's value at the moon's surface is $\frac{g}{6}$.

Satellite

A heavenly body revolving around a planet in an orbit is called a satellite. Moon is a natural satellite of the earth. The satellite may be artificial. Artificial satellites are of two types.

Geostationary Satellites

It revolves around the earth in equatorial orbits which is also called Geostationary or Geosynchronous orbit. The time period of these satellites is 24 hour.

Polar Satellites

These satellites revolve around the earth in polar orbits at a height of approximately 800 km.

Weather monitoring which is predicted on the basis of information about moisture present in air, atmospheric pressure etc, obtained through a **polar satellite.**

We are able to see a live telecast of cricket world cup match or other programme with the help of a communication satellite which is a geostationary satellite.

Time Period of a Satellite

It is the time taken by a satellite to complete one revolution.

If satellite is near the earth's surface, then $T = 2\pi\sqrt{\frac{R}{g}} \approx 84.6$ min.

Escape Velocity

Escape velocity: Escape velocity is that minimum velocity with which a body should be projected from the surface of earth so as it goes out of gravitational field of earth and never return to earth.

Escape velocity is independent of the mass, shape and size of the body and its direction of projection.

Escape velocity is also called second cosmic velocity.

For earth, escape velocity = 11.2 km/s.

For moon, escape velocity = 2.4 km/s.

Orbital velocity of a satellite $V_0 = \sqrt{gR}$ and escape velocity $V_e = \sqrt{2gR}$ where R = Radius of earth. i.e. $V_e = \sqrt{2}V_0$ i.e. escape velocity is $\sqrt{2}$ times the orbital velocity.

There if the orbital velocity of a satellite is increased to $\sqrt{2}$ times (increased by 41%), the satellite will leave the orbit and escape.

CHEMISTRY

ACID, BASE AND SALTS

1. Acid

- An acid is a compound, produce hydrogen ions, H+(aq), in solution, which are responsible for their acidic properties.
- According to Bronsted-Lowry theory, an acid is any species that can donate a proton to another species.
- Hydrogen ions cannot exist alone, but they exist after combining with water molecules.so, on dissolving in water yields hydronium ions (H_3O+) as the only positive ions.
- The presence of hydrogen ions make acids strong and good electrolytes.

Strong Acid:

- Examples of strong acids are: hydrochloric acid,sulphuric acid, nitric acid etc.

Weak Acid:

Examples are: acetic acid, formic acid, carbonic acid etc.

- Acids are generally sour in taste and corrosive.
- Indicators : Test whether a substance is acidic or basic. Eg: Turmeric, litmus, china rose petals (Gudhal), etc., are some of the naturally occurring indicators.
- Litmus is extracted from lichens a plant belonging to the division Thallophyta . It has a purple colour in distilled water. When added to an acidic solution, it turns red and when added to a basic solution, it turns blue.
- The solutions which do not change the colour of either red or blue litmus are known as neutral solutions. These substances are neither acidic nor basic.
- olfactory indicators:There are some substances whose odour changes in acidic or basic media.

Uses of Acids

- (i) Hydrochloric acid present in our stomach helps in the digestion of food.
- (ii) Vitamin C or ascorbic acid gives the needed nutrients for body.
- (iii) Carbonic acid is used in making carbonated beverages and fertilizers.
- (iv) Vinegar a preservative, is a dilute form of acetic acid.
- (v) Sulphuric acid is used in the manufacture of fertilizers, paints, synthetic fibres etc.
- (vi) Nitric acid is used in the preparation of aqua regia, used in the purification of precious metals like gold and silver.
- (vii) Boric acid is used to wash eyes.
- (viii) Phosphoric acid is used in making fertilizers and detergents.

- **Basicity of an acid** is defined as the no of ionizable hydrogen (H+) ions present in one molecule of an **acid**

Acids	Formulae	Basicity
Hydrochloric acid	HCL	1-Monobasic
Nitric acid	HNO_3	1-Monohabsic
Carbonic acid	H_2CO_3	2-Dibasic
Sulphuric acid	H_2SO_4	2-Dibasic
Phosphorous acid	H_3PO_3	2-Dibasic
Phosphoric acid	H_3PO_4	3-Tribasic

For the acid containing the carboxylic acid, we do not count the number of hydrogen atoms but the number of carboxyl group (i.e.) -COOH

ACIDS USED IN DAY-TO-DAY LIFE

Acids are obtained from two different sources. They can be organic or mineral acids. All acids have some common characteristic properties.

Sources of the acid	Name of the acid
Vinegar	acetic acid
Citrus fruits	citric acid
Grapes, tamarind, gooseberries.	tartaric acid
Sour milk	lactic acid
Apples	malic acid
Curd	butyric acid
Tea, tomatoes	oxalic acid
Sting of red ants and bees	formic acid
Proteins	amino acids
Guava, oranges	ascorbic acid

Note: The process of dissolving an acid or a base in water is a highly exothermic one. The acid must always be added slowly to water with constant stirring.

2. Bases and Alkalis

- A Base is a substance that gives OH-ions when dissolved in water. Bases are usually metal hydroxides (MOH).
- According to Bronsted-Lowry theory, a base is a proton acceptor.
- Bases are soapy substances with a bitter taste .
- The strength of a base depends on the concentration of the hydroxyl ions when it is dissolved in water.
- Bases soluble in water are called alkalies. All alkalies are bases but all bases are not alkalies.

Strong Base:

Examples:

Sodium hydroxide: NaOH (caustic soda),, Potassium hydroxide: KOH(caustic potash), Calcium hydroxide: $Ca(OH)_2$.

Weak Base:
Examples: Magnesium hydroxide: $Mg(OH)_2$, Ammonium hydroxide: NH_4OH.

SALT
Potash alum(potassium aluminum sulfate $KAl(SO_4)_2$**)**
(i) It is used in dyeing industries to fix the dye to the fabric.
(ii) It is used for cleaning teeth.

USES OF SALTS IN INDUSTRIES:
(i) Sodium chloride is used in the manufacture of chlorine, caustic soda, washing soda and baking soda.
(ii) Ammonium salts are used as fertilizers.
(iii) Potassium nitrate is used in the manufacture of gun powder and fire works.
(iv) Silver nitrate is used in photography.
(v) Potassium chlorate is used in the match industry.
(vi) Aluminium sulphate is used in preparing alums.

3. pH SCALE
The p in pH stands for 'potenz' in German, meaning power.

- The scale that measures the strength of an acid or a base is called the pH scale. This value lies between 0 and 14.
- Higher the hydronium ion concentration, lower is the pH value.
- The pH of a neutral solution is 7. Values less than 7 on the pH scale represent an acidic solution. As the pH value increases from 7 to 14, it represents an increase in OH– ion concentration in the solution, that is, increase in the strength of alkali.
- Most food crops grow best at a PH of 7-7.8.If the soil is too acidic then its pH can be raised by adding lime (or slaked lime) which neutralizes the excess acid in the soil.Similarly, if the soil is too alkaline then its pH can be lowered by adding gypsum or some other substance which can neutralize the excess alkali present in the soil.
- The medium in our stomach is highly acidic and has pH around 1.2. Our stomach produces hydrochloric acid which helps in digestion of food. Magnesium hydroxide (Milk of magnesia), a mild base, is an antacid which neutralises the excess acid.
- Tooth decay starts when the pH of the mouth is lower than 5.5.
- Acid Rain- When pH of rain water is less than 5.6, it is called acid rain.
- Gastric juice - 1.2
- Lemon Juice - 2.2
- Pure water - 7.4
- Milk of mgnesia - 10
- Sodium hydroxide solution - 14
- Note - The atmosphere of venus is made up of thick white and yellowish clouds of sulphuric acid.

STRUCTURE OF ATOM

The atomic theory of matter was first proposed by John Dalton.Fundamental particles of an atom are Electron, Proton and Neutron.

1. **Proton(p):** Discovered by E. Goldstein.

- Protons are positively charged.
- The absolute charge on the electron to be + 1.6 × 10–19 C.

2. Electron (e): Discovered by J.J. Thomson when he was studying the properties of cathode ray.

- Irish physicist George Johnstone Stoney **named** this charge '**electron**' in 1891.
- Electrons are negatively charged.
- The absolute charge on the electron to be – 1.6 × 10–19 C.
- e/m_e as: = 1.758820 × 1011 C kg–1
- The charge of an electron was measured by R. Millikan in Oil drop experiment.

3. Neutrons(n) - J. Chadwick

- It has no charge and a mass nearly equal to that of a proton.
- The mass of a neutron is taken as one unit each.

4. Atomic nucleus – Rutherford

- The fast moving alpha (α)-particles (doubly-charged helium ions) were made to fall on a thin gold foil.
- The mass of an atom is the sum of the masses of protons and neutrons present in the nucleus.

5. Valency

- The number of electrons gained, lost or shared so as to make the octet of electrons in the outermost shell, is called valency.
- The atoms of elements, having a completely filled outermost shell show little chemical activity,their valency is zero.
- An outermost-shell, which had eight electrons is said to possess an octet. Atoms would thus react, so as to achieve an octet in the outermost shell.
- The chemical behavior of an atom depend upon the number of electrons orbiting around the nucleus.

6. Atomic Number
The atomic number is defined as the total number of protons present in the nucleus of an atom. It is denoted by "Z".

7. Mass number
The mass number is defined as the sum of the total number of nucleons (protons and neutrons) present in the nucleus of an atom.

8. Isotopes

- Atoms which have the same atomic number but different mass numbers.The chemical properties of isotopes are similar but their physical properties are different.But some isotopes have special properties which find them useful in various fields. Some of them are :
- (i) An isotope of uranium is used as a fuel in nuclear reactors.
- (ii) An isotope of cobalt is used in the treatment of cancer.
- (iii) An isotope of iodine is used in the treatment of goiter

9. ISOBARS- Atoms of different elements with different atomic numbers, which have the same mass number, are known as isobars.

10. Isotones – atoms having same number of neutrons.

11. Isoelectronics – atoms/molecules/ions containing sae number of electrons.

12. Mass defect - The mass defect is the difference between the rest mass of a nucleus and the sum of the rest masses of its constituent nucleons.

13. Binding Energy

- The binding energy of a nucleus is the energy required to separate a nucleus into its constituent parts.
- For heavier nuclei, energy is released when they break up (fission).
- For lighter nuclei, energy is released when they fuse together (fusion).
- Nuclear particles are held together by a nuclear strong force.A stable nucleus remains forever, but as the ratio of N/Z gets larger, the atoms decay. Elements with Z > 82 are all unstable.
- As the heavier atoms become more unstable, particles and photons are emitted from the nucleus and it is said to be radioactive. All elements with A > 82 are radioactive.

Examples are:
Alpha particles - (2 proton and 2 neutron) least penetrating
beta-minus particles - (electron) penetrating
beta- plus particles - (positron) penetrating
Gamma rays - most penetrating, high electromagnetic radiation.

Half-Life period - The half half-life of an isotope is the time in which one one- half of its unstable nuclei will decay.
$N = N_0(1/2)^n$, Where n is number of half-lives

SOME COMMON ELEMENTS & COMPOUNDS

1. **Carbon:**
The three states of carbon are diamond, amorphous, and graphite.

- Carbon exhibits allotropy and shows maximum catenation.
- Carbon occurs both in free state as diamond, coal etc. and also in the combined form as CO_2.
- Diamond is one of the allotropic forms of carbon and is the purest form of natural carbon. It is the hardest natural substance.
- Graphite is also an allotropic form of carbon, which is very soft and slippery. Graphite are prepared artificially by Acheson process.
- Fullerene (C_{60}) looks like a soccer ball. It contains 20 six membered and 12 five membered rings of carbon atoms.
- Graphene is an allotrope of carbon. It is a strong substance and used as a conducting material for touch screen, LCD and LED

2. Compounds of Carbon

Carbon monoxide (CO)

- Carbon monoxide (CO) combines with haemoglobin to form carboxyhaemoglobin which is not able to absorb oxygen and as a result of this, suffocation takes place (Asphyxia).
- The death of persons in closed rooms with wood, coal or coke fires and in closed bathrooms with gas geyser is due to the formation of carbon monoxide.

Carbon dioxide (CO_2)

- 0.03-0.05 percent in atmosphere.
- Solid CO_2 is known as dry ice. It is used in refrigerators under the name drikold. It is used in transport of perishable food materials as it provides cold as well as the inert atmosphere.

Carbides
They are the compounds of carbon with metals or electronegative elements.

- Destructive distillation of coal gives products like coal gas, gas carbon, coal tar and ammonical liquor.
- Lamp Black is also known as Soot.

3. Nitrogen:

- Nitrogen is a neutral gas and is neither combustible nor a supporter of combustion.
- In air (79% by volume). In combined state, nitrogen is found as nitrates (Chile salt petre—sodium nitrate ($NaNO_3$), Indian salt petre—potassium nitrate (KNO_3)

4. Compounds of Nitrogen
Ammonia

- It is prepared from nitrogen and hydrogen by Haber's process. It has pungent odour.
- Ammonia is used in manufacturing fertilizers and explosives etc.

- Nitrogen fixation involves the fixation of atmospheric nitrogen into nitrate by lightning and by nitrogen fixing bacteria called **Rhizobia.**

Oxygen:

- Oxygen is an important constituent of atmosphere (21% by volume). Supporter of combustion.
- **Liquid oxygen** mixed with freshly divided carbon, is used in place of dynamite in coal mining.
- **Ozone(O_3) -** It protects the life on the earth by not allowing UV rays to reach the Earth.The common refrigerants, chlorofluorocarbons deplete this ozone layer.
- Its bleaching action is due to its oxidizing action.
- Ozone is also used as a germicide and disinfectant, for sterilizing water.

Phosphorus (P):

- It is highly reactive non-metal, so it occurs only in combined state.
- Phosphorus is an essential constituent of bones, teeth, blood and nerve tissues. Bone ash contains about 80% of phosphorus.

Sulphur (S):

- It occurs in free state in volcanic region.
- Rhombic sulphur is the most stable form at ordinary temperature and all other forms gradually change into this form.

Compounds of Sulphur

- **Sulphuric acid** is also known as **oil of vitriol** or **king of chemicals.** It has a great affinity for water and thus it acts as a powerful dehydrating agent. Corrosive action of sulphuric is due to its dehydrating action.
- **Hypo** (Sodium thiosulphate) It is mainly used in photography as a fixing agent. It is used to remove undecomposed silver halide on photographic paper or film.

Halogens:

Halogens are highly reactive elements and therefore, they do not exist in free state but exist only in combined form.
Halogens have highest electron affinity so they act as strong oxidizing agent.
Their oxidizing power decreases from fluorine to iodine.

Chlorine:

Chlorine was first discovered by Scheele (1774)
Chlorine is used as a germicide, disinfactant, oxidizing agent, bleaching agent in paper and textile industry.
Chlorine being an acidic gas turns moist blue litmus paper to red and then bleaches it.

Iodine (I_2)

Chile saltpeter or **caliche** contains iodine as sodium iodate (5-20%).
It turns starch solution blue. Solution of KI/I_2 is used in the treatment of goiter. It is used as an antiseptic as tincture of iodine.

Noble Gases

- Helium (He), neon (Ne), argon (Ar), krypton (Kr), xenon (Xe) and radon (Rn) are known as inert gases or noble gases or rare gases.
- These elements have completely filled valence shell.
- It atmosphere, argon is most abundant noble gas but in universe, helium is most abundant gas.
- Natural gas in the most important source of helium.
- The mixture of helium and oxygen is used for artificial breathing of asthama patients.
- 85% helium + 15% hydrogen is used for filling in balloons and airships.
- Mixture of helium and oxygen is used for respiration by sea divers.
- Helium is used as pressuring agent in rockets to expel liquid oxygen and liquid hydrogen.
- Xe is also known as stranger gas and Xe-Kr is used in high intensity photographic flash tubes.
- Radon is used in the preparation of ointment for the treatment of cancer.

Water (H2O):

- Water is called the "Universal Solvent".
- Hardness of water –
  Temporary hardness - Water is said to be temporarily hard when it contains bicarbonates of calcium and magnesium (or hydrogen carbonates). This type of hardness can be easily removed by boiling.
  Permanent hardness - Water is said to be permanently hard when it contains sulphates and chlorides of calcium and magensium.
  This hardness cannot be removed by boiling.
- **Degree of Hardness -** It is defined as the number of parts of $CaCO_3$ or equivalent to various calcium or magnesium salts present in 10^6 parts of water by mass.
- Heavy water is prepared either by prolonged electrolysis or by fractional distillation of ordinary water. Heavy water (D_2O) is colourless, tasteless and odourless liquid. Fission in uranium-235 is brought by slow speed neutron. Heavy water is used for this purpose in nuclear reactors as moderators.

Hydrochloric Acid (HCL):

- Hydrochloric acid is prepared by dissolving hydrogen chloride gas in water.

It reacts with metals to form their respective chlorides and liberates hydrogen.
Hydrochloric acid is used in the production of dyes, drugs, paints, photographic chemicals and in the preparation of aqua-regia. Aqua regia is a mixture of nitric acid and hydrochloric acid, optimally in a molar ratio of 1:3. Aqua regia is a yellow-orange fuming liquid because it can dissolve the noble metals gold and platinum

Nitric Acid (HNO_3):
It is manufactured by the Ostwald's Process by the reaction of ammonia and air in presence of platinum as catalyst.

- Nitric acid is colourless in pure form. Commercial nitric acid is yellowish due to the presence of dissolved nitrogen dioxide.
- Nitric acid is a strong monobasic acid. It ionizes in water readily.
- Nitric acid is a strong oxidizing agent. When it undergoes thermal decomposition, it yields nascent oxygen.

BAKING SODA

- Chemically Baking soda is sodium hydrogen carbonate, $NaHCO_3$.
- Baking soda is manufactured by Solvey's process

USES

1. Used for cooking of certain foods.
2. For making baking power (a mixture of sodium hydrogen carbonate and tartaric acid). On heating during baking, baking soda gives off carbon dioxide. It is this carbon dioxide which raises the dough. The sodium carbonate produced on heating the baking soda gives a bitter taste. Therefore, instead of using the baking soda alone, baking powder is used. The tartaric acid present in it neutralises the sodium carbonate to avoid its bitter taste.
3. In medicines Being a mild and non-corrosive base, baking soda is used in medicines to neutralise the excessive acid in the stomach and provide relief. Mixed with solid edible acids such as citric or tartaric acid, it is used in effervescent drinks to cure indigestion.
4. In soda acid fire extinguishers.

WASHING SODA

- Chemically, washing soda is sodium carbonate decahydrate, $Na_2CO_3.10H_2O$.
- Washing soda is manufacturing by Solvey's process.

USES

1. It is used in the manufacture of caustic soda, glass, soap powders, borex and in paper industry.
2. For removing permanent hardness of water.
3. As a cleansing agent for domestic purpose.

PLASTER OF PARIS

- Plaster of paris, also called POP.
- Chemically, it is $2CaSO_4.H_2O$ or $CaSO_4.1/2H_2O$ (calcium sulphate hemi hydrate)
- Gypsum, ($CaSO_4.H_2O$) is used as the raw material

USES

4. In making casts for manufacture of toys and statues.
5. In hospitals for making plaster casts to hold fractured bones in place while they set. It is also used for making casts in dentistry.
6. For making the surface of walls and ceiling smooth.
7. For making 'chalk' for writing on blackboard.
8. For making fire proof materials.

BLEACHING POWDER

- Bleaching is a process of removing colour from a cloth to make it whiter.
- Chemically, it is calcium oxychloride,$CaOCl_2$.
- It is manufactured by Hasen-Clever Method.

USES

1. For bleaching of cotton, linen and wood pulp.
2. In making wool unshrinkable.
3. Used as disinfactant and germicide for sterilization of water.
4. For the manufacture of chloroform.
5. Used as an oxidizing agent in chemical industry.

CHEMISTRY IN EVERYDAY LIFE

Synthetic Materials
The materials created by man using the natural materials, are known as synthetic materials.

Cement

- It was discovered by an English Mason, Joseph Aspdin in 1824. He called it Portland cement because he thought that it resembled the limestone found in Portland.
- **Approximate Composition of Portland cement**

Calcium oxide (CaO)	60-70%
Silica (SiO_2)	20-25%
Alumina (Al_2O_3)	5-10%
Ferric oxide (Fe_2O_3)	2-3%

- Raw materials are limestone (provides lime), clay (provides alumina and silica), gypsum (reduces the setting time of cement).
- When water is mixed with cement and left as such for sometime, it becomes a hard mass. This is know as setting of cement. It is an exothermic process, therefore cement structures have to be cooled upto 7 days by sprinkling water.
- Mortar is a mixture of cement, sand and water. It is used for plastering walls and binding bricks and stones.
- Concrete is a mixtures of cement, sand, gravel or small pieces of stone and water. It is used for the construction of floors.
- The structure having iron rods embedded in wet concrete, is known as **reinforced concrete**.

Glass ($Na_2O.CaO.6SiO_2$)

- It is a supercooled liquid of silicates.
- Raw material used for the formation of glass are sodium carbonate, calcium carbonate and sand.
- Finely powdered mixture known as **batch**, is mixed with cullet (broken glass pieces) and then fused in a tank furnace at 1673 K. After few hours, molten glass is obtained.
- Molten glass is cooled slowly and uniformly. The process of slow and uniform cooling is known as **Annealing**
- Different addition may produce different coloured glasses.

Substance used	Colour of glass
Cuprous oxide	Red
Cupric oxide	Peacock blue
Potassium dichromate	Green or Greenish yellow
Ferrous oxide	Green
Ferric oxide	Brown
Manganese dioxide	Light pink, in excess black
Cobalt oxide	Blue
Gold chloride	Ruby
Cadmium	Yellow
Carbon	Amber colour

Variety of glass and **Uses**

- **Soft glass** - It is a mixture of sodium or calcium silicates. It is used in making window glass, mirrors and common glass wares etc.
- **Hard glass** - It is a mixture of potassium and calcium silicates. It is more resistant to the action of acids for making hard glass apparatus.
- **Flint glass** - It is mainly a mixture of sodium, potassium and lead silicates. It is used in making bulbs and optical instruments.
- **Pyrex glass** (Borosilicate glass) - It is used in making pharmaceutical containers, lab apparatus and over ware.
- **Quartz glass** (Silica glass) - It is used in the preparation of chemical apparatus and optical instrument.
- **Crookes glass** - It is used for making lenses for spectacles.
- **Photochromatic glass** - On exposure to bright light, photochromatic glass darkens temporarily. So, it is very useful as a Sun shield.
- **Safety glass** - The three layers are joined together by the action of heat and pressure. It does not break easily under impact and is used in auto vehicle wind shield.
- **Optical glass** - It is used for making lenses for microscope, telescope and spectacles.
- **Glass fibres** - used as insulating material in oven, refrigerator etc.
- **Optical fibres** - are extensively used in telecommunication surgical operations etc. Optical fibres can transmit images round corners.
- **Lead crystal glass** - Lead glass has a high refractive index. So, it is used for making expensive glass ware.
- **Etching of glass** - Glass is attacked by hydrofluoric acid (HF), therefore it is used in the etching of glass.

CHEMICALS IN AGRICULTURE

Fertilizers

- Urea is the best fertilizer as it leaves only carbon dioxide after ammonia, has been assimilated by plants.
- It has 46.6% mitrogen and it does not alter the pH of the soil.
- Mixture of $Ca(CN)_2$ and C is known as **nitrolim**. Commerically, calcium nitrate is known as Norvegian salt petre.
- The mixture of nitrogenous, phosphatic and potash fertilizers in suitable amounts, is called **NPK fertilizers.**

Pesticides

Pesticides are the chemicals which are applied to crops, e.g. DDT and **malathion**.

Difethialone

Vitamin K has been suggested and +successfully used, as antidote for pets or humans accidentally or intentionally exposed to anticoagulant poisons.

Chemicals in medicines

Analgesics (Pain relievers)

These reduce pain. Aspirin and paracetamol are non-narcotic analgesics. Aspirin reduces fever, prevents platelet coagulation.

Narcotic analgesics are chiefly used for the relief of post operative pain, cardiac pain and pains of terminal cancer and in child birth.

Polymerization

- Polymers are defined as high molecular mass macromolecules, which consist of repeating structural units derived from the corresponding monomers.

- Polymers occur in nature also. Cotton, for example, is a polymer called cellulose.Cellulose is made up of a large number of glucose units.

On the basis of intermolecular forces Polymers are classified as:
1. Elastomers- rubber, buna-S, buna-N, neoprene etc.
2. Fibres – polyamides (nylon 6, 6), polyesters (Terylene), etc.
3. Thermoplastic polymers - Such plastic which gets deformed easily on heating and can be bent easily are known as thermoplastics. Polythene and PVC, Polythene, Polystyrene, Polyvinyls, etc.
4. Thermosetting Polymers - some plastics which when moulded once, can not be softened by heating. These are called thermosetting plastics.eg: bakelite, melamine etc.

Few important polymers are:

(a)Polythene
(i)Low density polythene-polymerisation of ethene under high pressure in the presence of traces of dioxygen or a peroxide initiator (catalyst).

(ii)High density Polythene - polymerisation of ethene in the presence of a catalyst such as triethylaluminium and titanium tetrachloride (Ziegler-Natta catalyst).

(b)Polytetrafluoroethene (Teflon)- Teflon is manufactured by heating tetrafluoroethene with a free radical or persulphate catalyst at high pressures.

(c)Polyacrylonitrile - polymer of acrylonitrile in presence of a peroxide catalyst.

Condensation Polymerisation

(a)Polyamides - possess amide linkages

(i) Nylon 6, 6 - prepared by the condensation polymerization of hexamethylenediamine with adipic acid under high pressure and at high temperature
ii) Nylon 6 - obtained by heating caprolactum with water at a high temperature.

(b)Polyesters - polycondensation products of dicarboxylic acids and diols. Polyester is another synthetic fibre. Fabric made from this fibre does not get wrinkled easily. It remains crisp and is easy to wash. So, it is quite suitable for making dress material.
Eg: Terylene is the best known example of polyesters. It is prepared by ethylene glycol and terephthalic acid.It can be drawn into very fine fibres that can be woven like any other yarn.

(c)Phenol - formaldehyde polymer (Bakelite and related polymers)
Prepared by the condensation reaction of phenol with formaldehyde in the presence of either an acid or a base catalyst.
The initial product could be a linear product – Novolac used in paints. Novolac on heating with formaldehyde undergoes cross linking to form an infusible solid mass called bakelite. It is used for making combs, phonograph records, electrical switches and handles of various utensils.

Eg. Melamine – Melamine formaldehyde polymer is formed by the condensation polymerisation of melamine and formaldehyde. Melamine is a versatile material. It resists fire and can tolerate heat better than other plastics. It is used for making floor tiles, kitchenware and fabrics which resist fire. It is used in the manufacture of unbreakable crockery.

Copolymerisation.

Natural rubber - Natural rubber may be considered as a linear polymer of isoprene (2-methyl-1, 3-butadiene) and is also called as cis - 1, 4 - polyisoprene.

Vulcanisation of rubber-This process consists of heating a mixture of raw rubber with sulphur and an appropriate additive at a temperature range between 373 K to 415 K so that rubber gets stiffened.

Synthetic Rubbers -
(i) Neoprene - by the free radical polymerisation of chloroprene.
Rayon - rayon or artificial silk. Although rayon is obtained from a natural source, wood pulp, yet it is a man-made fibre.
Nylon - Nylon is also used for making parachutes and ropes for rock climbing. A nylon thread is actually stronger than a steel wire.

CLASSIFICATION OF ELEMENTS

Mendeleef's Periodic Table (1869)
States that,"the physical and chemical properties of elements are the periodic function of their atomic masses."

Modern Periodic Law
"The physical and chemical properties of the elements are periodic function of their atomic numbers."

Long Form of Periodic Table
Long form of periodic table or Bohr's table is based on **Bohr-Burry concept** of electronic configuration. It contains 7 periods (horizontal rows) and 18 groups.

Periodic Properties
The properties which are repeated at regular intervals are known as periodic properties, i.e. periodic properties show a regular order along a group and period. Some important periodic properties are

Ionisation enthalpy

It is the minimum energy required to remove an electron from an isolated gaseous atom of an element to form a positive ion.

Electron gain enthalpy
It is the energy released by an element when an extra electron is added to its neutral gaseous atom.

Electronegativity
It is the ability of an atom to attract the shared pair of electrons towards it.

Metallic character
It is the tendency of an element to form cation by the loss of electrons.

CHEMICAL REACTIONS AND EQUATION

Physical Change
- The change that only affect physical properties, but the chemical compositions remains unchanged, are called **physical change**.
- These can be reversed by changing the conditions of temperature and pressure, boiling, cutting of trees, dissolving common salt in water burning of wax.

Chemical Change
- The change which affect the composition as well as chemical properties of matter and result in the formation of a new substance is called a chemical change.
- Chemical changes are generally irreversible. Some examples of chemical changes are burning of candle (gases), photosynthesis, ripening of fruits, electrolysis of water.
- A chemical reaction involves bond breaking or bond formation between any two atoms to produce new substances.

Types of Chemical Reactions.

Exothermic and Endothermic Reactions
Reactions in which heat is released along with the formation of products, are called **exothermic reactions**. Burning of fuel is an example of exothermic reaction.
Reactions in which heat is absorbed, are known as **endothermic reactions.**

Oxidation and Reduction
- Oxidation is removal of electrons.
- Reduction is the addition of electrons.
- Oxidation means
  (a) addition of oxygen
  (b) removal of hydrogen.
- Reductions means
  (a) Removal of oxygen.
  (b) Addition of hydrogen.
- The substance that causes oxidation is called the oxidizing agent.
- The substance that causes reduction is called the reducing agent.

Oxidising agent
1. Acceptors of electrons.
2. It is a substance which removes the electron from an atom.
3. It brings about oxidation.

Reducing agent
1. Donors of electrons.
2. It is a substance which adds electrons to an atom.
3. It brings about reduction.

REDOX REACTION
A reaction which involves oxidation and reduction occurring simultaneously together are called redox reaction. Photosynthesis in plants digestion of food in animals; dry and wet batteries and corrosion of metals are diverse examples of oxidation and reduction reactions.

Electrolysis
- Electrolysis is carried out in an electrolytic cell.
- A simple electrolytic cell consists of two copper strips dipping in an aqueous solution of copper sulphate.
- On applying DC voltage to the two electrodes, copper metal is deposited on cathode and copper is dissolved at anode.
- Used In the purification of impure metals.
- In the extraction of metals
- The blocks used in typing industries are prepared by electrolysis.
- Steel is coated with zinc metal during the process of galvanization.

Batteries
These convert chemical energy into electrical energy. Mainly two types of batteries are used, i.e. primary and secondary.

Primary Batteries
In the primary batteries, reaction occurs only once and after a period of time battery becomes dead.

Dry Cell or Leclanche Cell
It consists of a zinc container that acts as anode and the cathode is a carbon (graphite) rod surrounded by powdered manganese dioxide and carbon.
A moist paste of ammonium chloride (NH_4CI) and zinc chloride ($ZnCI_2$) is used as an electrolyte. Dry cell is commonly used in our transistors and clocks.

Mercury Cell
It is commonly used in low current devices such as hearing aids, watches etc.

The electrolyte is a past of potassium hydroxide (KOH) and zinc oxide (ZnO).

Secondary Batteries

Lead Storage Battery

It consists of a lead as anode and a grid of lead packed with lead dioxide (PbO_2) as cathode.

A 38% solution of sulphuric acid is used as an electrolyte. On charging the battery, the reaction is reversed and lead sulphate gives lead on anode and cathode is converted into lead dioxide respectively.

Nickel Cadmium Cell

It has longer life that the lead storage cell. It consists of a cadmium as anode and nickel dioxide as cathode. The electrolyte is a potassium hydroxide (KOH) solution.

Fuel Cells

Fuel cells convert energy from the combustion of fuels such as hydrogen, carbon monoxide, methane directly into electrical energy

A fuel cell with hydrogen and oxygen has been used for electric power in Apollo Space Programme.

Corrosion

- When iron is exposed to moist air for a long period of time, its surface acquires a coating of brown flaky substance called **rust**.
- Rust is mainly hydrated iron (III) oxide ($Fe_2O_3.xH_2O$).
- In corrosion, a metal is oxidized by the loss of electrons to oxygen and form oxide.
- The rusting of iron can be prevented by painting, oiling and greasing, galvanizing (by coating iron objects with zinc), chrome plating etc.

Catalysis

- A catalyst is a substance which alter the rate of reaction.
- The catalyst itself does not alter during the reaction.
- The phenomena in which the rate of reaction is altered by the presence of a substance (**catalyst**) is known as catalysis.
- Catalysts are specific in their action.
- A catalyst does not change the equilibrium state of a reversible reaction, only brings it quickly.
- The main function of a catalyst in a reaction is to decrease the activation energy.

Applications of Catalysts in Industrial Processes

- Haber process for ammonia—Iron is used as a catalyst and molybdenum is used as a promoter of catalyst iron.
- Contact process for sulphuric acid—Vanadium pentoxide is used as a catalyst.
- Ostwald process for nitric acid—Platinum gauze is used as a catalyst.
- Deacon process for chlorine—Cupric chloride is used as a catalyst.
- Synthesis of petrol—Nickel, iron, cobalt and alumina is used as a catalyst.

Enzyme Catalysis

The increase in the rate of reaction by the enzymes is known as enzyme catalysis. They are biocatalysts, all are proteins in nature.

The rates of enzymatic reactions are very much affected by pH change.

Some important enzyme catalysis reactions are as follows

- $\text{Starch} \xrightarrow[H_2O]{\text{Diastase}} \text{Maltose}$
- $\text{Maltose} \xrightarrow[H_2O]{\text{Maltase}} \text{Glucose}$
- $\text{Glucose} \xrightarrow{\text{Zymase}} \text{Ethyl alcohol}$
- $\text{Sucrose} \xrightarrow{\text{Invertase}} \text{Glucose + Fructose}$
- $\text{Urea} \xrightarrow[H_2O]{\text{Urease}} \text{Ammonia + Carbon dioxide}$

MATTER AND ITS NATURE

- Matter can exist in three states-
  I. Solid
  II. Liquid
  III. Gas.
- The forces of attraction between the particles(inter-molecular force) are maximum in solids, intermediate in liquids and minimum in gases. The spaces in between the constituent particles and kinetic energy of the particles are minimum in the case of solids, intermediate in liquids and maximum in gases.
- The states of matter are inter-convertible. The state of matter can be changed by changing temperature or pressure.
- The process of melting, that is, change of solid state into liquid state is also known as fusion.
- Evaporation is a surface phenomenon. Particles from the surface gain enough energy to overcome the forces of attraction present in the liquid and change into the vapour state. The rate of evaporation depends upon the surface area exposed to the atmosphere, the temperature, the humidity and the wind speed. Evaporation causes cooling.
- Burning of coal, wood or leaves is a chemical change. Explosion of a firework is a chemical change. If you leave a piece of iron in the open for some time, it acquires a film of brownish substance. This substance is called rust and the process is called rusting. The process of rusting can be represented by the following equation: Iron (Fe) + Oxygen (O_2, from the air)water (H_2O) rust (iron oxide-Fe_2O_3) For rusting, the presence of both oxygen and water (or water vapour) is essential. It is a chemical change.
- Prevent iron articles from coming in contact with oxygen, or water, or both. One simple way is to apply a

coat of paint or grease. Another way is to deposit a layer of a metal like chromium or zinc on iron. This process of depositing a layer of zinc on iron is called galvanisation.

- Stainless steel is made by mixing iron with carbon and metals like chromium, nickel and manganese. It does not rust.
- Changes attended with absorption of heat are called endothermic changes, while those which occur with evolution of heat are called exothermic changes. The reactions in which heat is absorbed are known as endothermic reactions, while chemical reactions which evolve heat are called exothermic. The compounds formed from their elements with absorption of heat are called endothermic compounds, whilst those formed from their elements with evolution of heat are called exothermic compounds.

Solution

- A solution is a homogeneous mixture of two or more substances. The major component of a solution is called the solvent, and the minor, the solute. Lemonade, soda water etc. are all examples of solutions. We can also have solid solutions (alloys) and gaseous solutions (air).
- The solute particles cannot be separated from the mixture by the process of filtration. The solute particles do not settle down when left undisturbed, that is, a solution is stable.
- The concentration of a solution is the amount of solute present per unit volume or per unit mass of the solution/solvent. A suspension is a heterogeneous mixture.
- Colloids are heterogeneous mixtures in which the particle size is too small to be seen with the naked eye, but is big enough to scatter light.
- The particles are called the dispersed phase and the medium in which they are distributed is called the dispersion medium.

Metals & Nonmetals

- Metals are generally **good conductors of heat and electricity**.
- Silver is the best conductor of heat followed by copper.
- Mercury offers a very high resistance to the passage of electric current.
- Metals are generally **hard** but sodium and potassium are so **soft** that they can be easily cut with a knife.
- Metals are malleable and ductile. Gold and silver are most malleable and best ductile metals.
- Metals are solids at room temperature except mercury (mp – 39°C) which is liquid, caesium (mp 28.4°C) and gallium (mp 29.8°C) are liquid above 30°C.
- Metals are electropositive in nature, they ionize by the loss of electrons and form positive ions.
- Almost all the metal oxides are basic in nature but zinc oxide and aluminium oxide are amphoteric.
- Lithium, sodium, potassium, rubidium and caesium are alkali metals. Alkali metals are stored under kerosene or liquid paraffins to protect them from action of air.
- Metallic sodium is prepared by the electrolysis of molten mixture of 40% sodium chloride and 60% calcium chloride in a **Down's cell**.
- **Sodium bicarbonate**($NaHCO_3$), baking soda is used in effervescent drinks and fruit salts in fire extinguishers and it is also used in the form of sesquicarbonate. It is used for wool washing.
- **Sodium carbonate** ($Na_2CO_3.10H_2O$) washing soda is used in the manufacturing of glass, soap, washing powder and for softening hard water.
- Mixture of sodium carbonate and potassium carbonate is known as **fusion mixture**.
- **Sodium sulphate** ($Na_2SO_4.10H_2O$) is Glauber's salt. It is used as purgative.
- **Sodium thiosulphate** ($Na_2S_2O_3.5H_2O$) or **Hypo** It is used in the photography as a fixing agent.
- **Potassium superoxide** (KO_2) used in space capsules, submarines and breathing masks as it produces oxygen and removes carbon dioxide and carbon monoxide.
- **Potassium** cyanide (KCN) is used in the extraction of silver, gold and as a germicide in agriculture. KCN is more poisonous than sodium cyanide.
- Potassium hydroxide (KOH) is known as caustic potash used in the preparation of soft soap. Its aqueous solution is known as **potash lye.**
- **Potassium carbonate** (K_2CO_3) is potash or pearl ash.

De-icing of Roads after snowfall

De-icing in the process of removing ice from a surface by using salts on the surface. Now-a-days, liquid $CaCI_2$ and $MgCI_2$ are also used for this purpose.

Alkaline Earth Metals and their Compounds

Beryllium, magnesium, calcium, strontium, barium and radium are collectively known as alkaline earth metals. Be $(OH)_2$ is amphoteric in nature. Mg $(OH)_2$ is called **milk of magnesia** and used as an **antacid.**

Calcium oxide (CaO) is also called **quick lime**. It is used in the manufacturing of glass, calcium chloride, cement, bleaching power, calcium carbide, slaked lime, in the extraction of iron and as a drying agent for ammonia and alcohol.

Calcium hydroxide, slaked lime [$Ca(OH_2)$] is used in the manufacturing of caustic soda, sodalime and for softening of hard water.

Calcium sulphate, gypsum ($CaSO_4.2H_2O$) loses a part of its water of crystallization when heated upto 120°C to from $[CaSO_4]_2.H_2O$ which is known as **plaster of Paris**.

Plaster of Paris is a white powder, which sets into hard mass on wetting with water and it is used in making statues,

toys, etc., in medical applications of setting fractured bones in right positions and indentistry.

Some Important Metals and their Uses

Boron (B)
It is a semimetal (metalloids). In the nature, it occurs in combined state as borax.
Boron and boron carbide rods are used to control the nuclear reactions.
Boron carbide (B_4C) is hardest, known as an artificial substance after diamond and is known as **Norbia.**
Orthoboric acid (H_3BO_3) is used as an antiseptic and eye wash under the name boric lotion.

Aluminium (Al)
It is a third most abundant element of Earth's crust. It is extracted from bauxite ($AI_2O_3.2H_2O$). Aluminium powder is used in fireworks, flash light powder, thermite welding.
Ammonal (a mixture of aluminium powder and ammonium nitrate) is used as an explosive.
Ruby and sapphire are essentially AI_2O_3. Ruby is red due to the presence of Cr and sapphire is blue due to Fe and Ti. Emerald is green, it contains Ca/Cr and aluminium silicates (AI_2SiO_3).

Tin (Sn)
The important ore of tin is cassiterite (SnO_2) or tin stone. In cold countries, white tin is converted to grey tin (powder), the process is known as **tin disease** or **tin plague.** Tin plating is done to prevent the rusting of iron. Tin amalgam is used in making mirrors. Pentahydrate of stannic chloride ($SnCI_4.5H_2O$), is called butter of tin used as mordant in dyeing.

Lead (Pb)
Lead is mainly found in the form of sulphide ore called **galena** (PbS). Red lead (minium or sindhur) is Pb_3O_4 used for making protective paint for iron and in match industry.

Zirconium (Zr)
It is used for making core of nuclear reactors and for making pumps, valves and heat exchangers.

Vanadium (V)
Vanadium pentoxide (V_2O_5) is a very good catalyst for manufacturing of sulphuric acid by contact process.

Tungsten
Tungsten filaments are used in electric bulbs. Calcium tungstate is used in X-ray tube.

Iron (Fe)
It is extracted from its haematite ore.

Cast iron It is the most impure form of iron and contains 2.5–4% carbon.

Wrought iron or **Malleable iron** is the most purest form of iron and contains minimum amount of carbon (0.12–0.5%) Iron (II) is present in haemoglobin (blood).

Mild steel contain 0.25%–0.5% carbon while hard steels contains 0.5%–1.5% carbon. Soft steels contain carbon upto 0.25%.

Stainless steel is an alloy of iron (Fe), chromium (Cr) and nickel (Ni). Ferric chloride ($FeCI_3$) is used as stypic to stop bleeding from a cut. Ferrous sulphate ($FeSO_4$) is used in making blue black ink.

Copper, Silver and Gold (Cu, Ag and Au)
These are called coinage metals. Silver is used as amalgam for filling teeth and in silvering mirrors. Silver bromide (AgBr) is used in photography. $AgNO_3$ is called **lunar caustic** used in preparing marking inks and hair dyes.
$CuSO_4.5H_2O$ is called **blue vitriol** or **nila thotha** and $CuFeS_2$ is called fool's gold.

Mercury (Hg)
Mercuric sulphide (HgS) is used as a cosmetic in Ayurvedic medicine as Makardhwaja.

Zinc (Zn)
It is used in galvanization to prevent rusting of iron. Zinc sulphide is used in the preparation of X-ray screens.
Zinc oxide is known as **philosopher's wool**. Zinc sulphate ($ZnSO_4.7H_2O$) is white vitriol.

Metallurgy
The process of extraction of metals from their ores is called metallurgy.

Minerals, Ores and Gangue
The natural substance in which metals and other impurities found in combined state, are called minerals.
The minerals from which metal can be extracted conveniently and beneficially, are called ores. **Gangue or matrix** are the impurities associated with the ore.

Metal	Ores	Chemical composition
Sodium	Rock salt Chile salt petre Borax	NaCI $NaNO_3$ $Na_2B_4O_7.10H_2O$
Potassium	Carnallita Sylvine	$KCI.MgCI_2.6H_2O$ KCI
Magnesium	Carnallite Magnesite Asbestos	$KCI.MgCI_2.6H_2O$ $MgCO_3$ $CaSiO_3.3MgSiO_3$
Calcium	Lima stone Gypsum Fluorspar	$CaCO_3$ $CaSO_4.2H_2O$ CaF_2
Aluminium	Bauxite Cryolite	$AI_2O_3.2H_2O$ Na_3AIF_6

	Feldspar	$KAlSi_3O_8$
Manganese	Pyrolusite Manganite Manganese blende	MnO_2 $Mn_2O_3.H_2O$ MnS
Iron	Haematite Magnetite Iron pyrites Siderite	Fe_2O_3 Fe_3O_4 FeS_2 $FeCO_3$
Copper	Copper glance Copper pyrites Malachite Azurite	Cu_2S $CuFeS_2$ $Cu(OH)_2.CuCO_3$ $2CuCO_3.Cu(OH)_2$
Silver	Silver glance Horn silver	Ag_2S AgCI
	Ruby Silver	$Ag_2S.Sb_2S_3$
Gold	Calverite Sylvanite	$AuTe_2$ $AuAgTe_4$
Zinc	Zinc blende Calamine Zincite Franklinite	ZnS $ZnCO_3$ ZnO $ZnO.Fe_2O_3$
Mercury	Cinnabar	HgS
Tin	Cassiterite	SnO_2
Lead	Galena Cerrusite Anglesite	PbS $PbCO_3$ $PbSO_4$

Some Important Alloys and their Uses

Non-Metals

These may be solid, liquid or gas (bromine is the only liquid non-metal).

These are soft, non-lustrous, brittle, non-sonorous and non-conductor of heat and electricity. These have low melting and boiling points. These from oxides with oxygen which are generally acidic. Their examples include noble gases, i.e. helium (He), neon (Ne), argon (Ar), krpton (Kr), xenon (Xe) and some other p-block elements like chlorine (CI_2), bromine (Br_2) and phosphorus (P) etc.

Alloys are homogeneous mixtures of metals and cannot be separated into their components by physical methods.

Pure metals have poor mechanical properties. Hence, they are not used in their pure form in industry. Their properties are modified by adding other elements.

Characteristics of alloys:

Alloys are harder and tougher than the base metal and are resistant to corrosion.

They are inert to commonly used chemicals and are magnetisable and ductile.

Alloy is considered as a mixture because it shows the properties of its constituents and can have variable composition.

Amalgams:

Alloys of mercury with other metals like sodium, potassium,gold and zinc...etc are called amalgams.

Amalgams stored in iron bottles as iron cannot form amalgam with mercury.

Rold Gold is a metal, such as brass, coated with a thin layer of gold, usually of above 9 carat purity.

Brass

Composition- zinc 30%, copper 70%

uses- In making of utensils, pipes and radiator statues etc.

Yellow Brass

composition - Cu 67%, Zn 33%

uses - Hardware items

Bronze

Composition - Copper 90%, Tin 10%

uses - In making of coins, ornaments, utensils and statues.

Stainless steel

composition - Fe 82%,(Ni + Cr) 18

uses - In making of surgical instruments, watches and utensils etc.

Magnalium

composition- Al 95% ,Mg 5%

uses - In making light articles and physical balance etc.

Duralumin

composition- Al 95%, Cu 4% ,Mn 0.5%

uses -In making parts of aeroplane and ship etc.

Alnico

composition - Al 8-12% , Ni 15-26% , Co 5-24% ,Cu 6%

Remaining: Fe, Tl

uses - It is useful in making of magnets.

German silver

composition - Cu 60% ,Zn 20%, Ni 20%

uses - It is useful in electroplating and making of utensils.

sterling Silver

composition - silver 92.5%, copper 7.5%

uses - jewelry, art object

Gun metal

composition - Cu 88%, Sn 10%,Zn 2%

uses - It is useful in making of guns, machine parts and canons..etc

Solder metal

composition - Pb 50%, Sn 50%

uses - It is mainly useful to join electric wires.

Bell Metal-

composition - copper - 77%, tin - 23%

uses- casting of bells

coin metal -
composition - copper 75%, nickel 25%
uses - U.S coins

wood's metal
composition - Bi 50%, Pb 25%, Sn 12.5%, Cd 12.5%
uses - fuse plugs, automatic sprinklers.

Monel
composition - Ni 67%,and copper, with small amounts of iron, manganese, carbon, and silicon.
uses - It is resistant to corrosion and acids and thus used for making valves, pumps, shafts, fittings, fasteners, and heat exchangers.

Plumber's solder
composition - Pb 67%, sn 33%
uses- soldering joints.

CHEMICAL BONDING

Chemical Bonding

Constituents (atoms, molecules or ions) of different elements except noble gases, do not have complete octet so they combine with other constituent atoms by chemical bonds to achieve complete (stable) octet. The process of their combination is called chemical bonding. Chemical bonding depends upon the valency of atoms.

Types of Chemical Bond

They are divided in the following types depending upon the mode electron transferred or shared electrons or forces of attraction

- Electrovalent or ionic bond
- Covalent bond
- Coordinate or dative covalent bond
- Hydrogen bond
- van der Waals' forces

Electrovalent Bond

The bond formed by the transfer of electrons from one atom to another is called electrovalent bond and the compound is called **electrovalent compound** or **ionic compound**. These bonds are formed between metals and non-metals.
These conduct electricity when dissolved in water and also soluble in water. These are insoluble in organic solvents like alcohol etc.

Some Electrovalent Compounds (Ionic Compounds)

Name	Formula	Ions present
Aluminium oxide (Alumina)	Al_2O_3	Al^{3+} and O^{2-}
Ammonium chloride	NH_4Cl	NH_4^+ and Cl^-
Calcium chloride	$CaCl_2$	Ca^{2+} and Cl^-

Covalent Bond

The bond is formed by the sharing of electrons between two atoms of same (or different) elements, is called covalent bond.
Covalent bond may be single, double or triple depends upon the number of sharing pairs of electrons.
Covalent compounds are usually liquids or gases having low melting point and boiling point. These do not conduct electricity and are insoluble in water but dissolve in organic solvent.

Some Covalent Compounds

Name	Formula	Element's part
Alcohol (Ethanol)	C_2H_5OH	C, H and O
Ammonia	NH_3	N and H
Acetylene (Ethyne)	C_2H_2	C and H

Coordinate or Dative Bond

The bond is formed by one sided sharing of one pair of electrons between two atoms. The necessary condition for the formation of coordinate bond is that octet of one atom should be complete, having atleast one lone pair of electrons and other atom should have a deficiency of atleast one pair of electrons.
The atom having complete octet which provides the electron pair for sharing, is known as **donor**. The other atom which accept the electron pair, is called the **acceptor**.

Bonding between A and B is predominantly
– Ionic if there is large difference in electronegativity.
– Covalent if both A and B have approximately same value of electronegativity.
– Coordinate if lone pair on A (or B) is donated to electron deficient B (or A).

Compounds Containing Ionic and Covalent Bonds

Name	Formula
Potassium cyanide	KCN
Sodium hydroxide	NaOH
Calcium carbonate	$CaCO_3$

Compounds Containing Covalent and Coordinate Bonds

Name	Formula
Carbon monoxide	CO
Ozone	O_3
Dinitrogen oxide	N_2O
Dinitrogen trioxide	N_2O_3
Nitric acid	HNO_3

Compounds Containing Electrovalent, Covalent and Coordinate Bonds

Name	Formula
Ammonium chloride	NH_4CI
Ammonium bromide	NH_4Br

Hydrogen Bond

The electrostatic force of attraction between hydrogen atom (which is covalently bonded to a highly electronegative atom) and any other electronegative atom which is present in the same or different molecules, is known as hydrogen bond.

It is maximum in the solid state and minimum in the gaseous state.

- **Intermolecular H-bonding** (e.g. HF, water (H_20) molecule) It occurs between different molecules of a compound and results in increasing solubility in water and high boiling point.
- **Intramolecular H-bonding** (e.g. o -nitrophenol) It occurs within different parts of a same molecule and results in decreasing solubility in water and low boiling point.
- Molecules having O—H, N—H or H—F bond show abnormal properties due to H-bond formation. For example
- Glycerol is viscous and has very high boiling point due to the presence of intermolecular H-bonding.
- H-bonding also plays an important role in biological system and stability of proteins and nucleic acids.

van der Waals' Forces

The ability of geckos (lizard) which can hang on a glass surface using only one toe to climb on sheer surfaces had been attributed to the van der Waals' forces between these surfaces and their foot-pads.

ATMOSPHERIC POLLUTION

Atmospheric pollution

The substance which causes pollution is known as pollutant.

Pollutants are of two types

— **Primary pollutants** persist in the environment in the form, they are produced, e.g. sulphur dioxide (SO_2), nitrogen dioxide (NO_2) etc.

— **Secondary pollutants** are the products of reaction of primary pollutants, e.g. peroxyacetye nitrate (PAN), ozone (O_3), aldehyde etc.

Major Gaseous Air Pollutants

Major gaseous air pollutants are oxides of sulphur, nitrogen, carbon and hydrocarbons.

Sulphur dioxide (SO_2)

It is highly toxic for both animals and plants, bronchitis, asthma, emphysema. It also causes eye and throat irritation and breathlessness.

Sulphur dioxide reduces the rate of formation of chloroplast and thus, causes chlorosis. SO_2 is highly corrosive and damage buildings, marbles (Taj Mahal) and textiles.

SO_2 is oxidized to SO_3 which reacts with water to give H_2SO_4. H_2SO_4 remains suspended in the air as droplets or come down in the form of acid rain.

Oxides of nitrogen

Among the oxides of nitrogen, nitric oxide (NO), a colourless, odourless gas and nitrogen dioxide (NO_2), a brown gas with pungent odour act as tropospheric pollutants.

NO_2 is highly toxic for living tissues causes leaf fall. It is a corrosive oxide and helps in the formation of smog.

In the presence of oxygen, NO_2 reacts with water or moisture and produces nitric acid (HNO_3) which is an important factor for making acid rain.

Carbon monoxide (CO)

From more stable carboxyhaemoglobin complex with haemoglobin due to which the delivery of oxygen to the organs and tissues is blocked.

Hydrocarbons

Out of the hydrocarbons, methane (CH_4) is the most abundant hydrocarbon pollutant. Higher concentrations of hydrocarbons given carcinogenic effect, i.e. are cancer producing. They cause ageing of plants, breakdown of plant tissues and shedding of leaves.

Consequences of Atmospheric Pollution

Green house gases such as carbon dioxide, methane and water vapours trap the heat radiated from Earth. This leads to an increase in Earth's temperature. This heating up of Earth and its objects due to the trapping of infrared radiation by green house gases in the atmosphere, is called **green house effect.**

Green house effect is very essential for the existence of life because in its absence, Earth would be converted into extremely cold planet. When concentration of green house gases increases, green house effect also increases. This is known as **global warming.**

Acid rain

It is caused by the presence of oxides of nitrogen and sulphur in the air. These oxides dissolve in rain water and from nitric acid and sulphuric acid respectively. The rain carrying acids, is called acid rain.

Particulates

Diseases caused by particulate

Diseases	Cause
Pneumoconiosis	Due to inhalation of coal dust
Silicosis	Due to inhalation of free silica (SiO_2)
Black lung disease	Found in workers of coal mines
White lung disease	Found in textile workers
Byssinosis	Due to inhalation of cotton fibre dust

Smog

It is two types:

Classical smog

These occur in cool, humid climate. Sulphur dioxide (SO_2) and particulate matter from fuel combustion are the main components of classical smog.

Photochemical smog

These occur in warm, dry and sunny climate. It consists of a mixture of primary pollutants (nitrogen oxides and carbon monoxides) and secondary pollutants (ozone, formaldehyde).

Peroxyacetyl nitrate (PAN) and aldehydes present in smog causes irritation in eyes. PAN has the highest toxicity to plants. It attacks younger leaves and causes bronzing and glazing of their surfaces.

Stratospheric Pollution

In stratosphere, ozone layer absorbs the ultraviolet radiation of the Sun which are harmful to living organisms.

Depletion of ozone layer causes skin cancer and cataract in human and reduction of planktons in ocean and depletion of plants.

Depletion of ozone layer is caused by **chlorofluoro carbons** which are used in refrigeration, fire extinguishers and aerosol sprayers.

In stratosphere, the depletion of ozone layer leading to ozone hole has been mainly observed in the stratosphere of Antarctica.

The formation of this hole occur due to the accumulation of special clouds in the region called **Polar Stratospheric Clouds** (PSCs) and inflow of chlorofluoro carbons (CFCs).

Water pollution

In some part of India, drinking water is contaminated by the impurities of arsenic, fluoride, uranium, etc.

In water, some dissolved Oxygen (DO) is also present. For a healthy aquatic life, the optimum value of DO is 5-6 ppm. If DO is below 5 ppm, the growth of fishes is inhibited.

Biochemical Oxygen Demand (BOD) is the total amount of oxygen (in mg) required by microbes to decompose the organic matter present in 1L of water sample while **Chemical Oxygen Demand** (COD) refers to the total amount of oxygen (in ppm) consumed by the pollutants in a water sample.

$$\text{BOD} = \frac{\text{Amount of oxygen required (in mg)}}{\text{Volume of water sample (in L)}}$$

For clean water, BOD is less than 5 ppm while for highly polluted water, it is 17 ppm or more.

PROPERTIES OF GASES

1. Properties of Gases

- Gas has no definite volume or shape.
- The other outstanding characteristic of gases is their low densities, compared with those of liquids and solids.
- All gases expand equally due to equal temperature difference.
- **Diffusion of gases:** The phenomenon in which a substance mixes with another because of molecular motion, even against gravity- is called diffusion.
- **The pressure of a gas:** The molecules of a gas, being in continuous motion, frequently strike the inner walls of their container
- Temperature and Temperature Scales: Temperature is defined as the measure of average heat. Temperature is independent of the number of particles or size and shape of the object.
- **Compressibility:** Particles of a gas have large intermolecular spaces among them. By the application of pressure much of this space can be reduced and the particles be brought closer. Hence the volume of a gas can be greatly reduced. This is called compressing the gas.

Gas Laws

- All gases, irrespective of their chemical composition, obey certain laws that govern the relationship between the volume, temperature and pressure of the gases. A given mass of a gas, under definite conditions of temperature and pressure, occupies a definite volume. When any of the three variables is altered, then the other variables get altered. Thus these Gas laws establish relationships between the three variables of volume, pressure and temperature of a gas.

- **Boyle's Law:** "The product of the volume and pressure of a given mass of dry gas is constant, at constant temperature".
- **Charles' Law:** "At constant pressure, the volume of a given mass of gas increases or decreases by 1/273 of its original volume at 32°F, for each degree centigrade rise or lowering in temperature."
- **Pressure Law:** Volume remaining constant, the pressure of a given mass of gas increases or decreases by a constant fraction (=1/273) of its pressure at 0°C for each degree Celsius rise or fall of temperature.
- **Avogadro's Law:** This is quite intuitive: the volume of a gas confined by a fixed pressure varies directly with the quantity of gas. Equal volumes of gases, measured at the

same temperature and pressure, contain equal numbers of molecules. Avogadro's law thus predicts a directly proportional relation between the number of moles of a gas and its volume.

- **Gay-Lussac's Law:** When different gases react with each other chemically to produce gaseous substances, then under the same condition of temperature and pressure, the volume of the reacting gases and product gases bear a simple ration among one another.

- **Avogadro Number:** From Avogadro's hypothesis, we know equal volume of all gases contain equal number of molecules at normal temperature and pressure.
  The number is known as Avogadro Number and is equal to6.06X1023.
- **The ideal gas equation of state:** If the variables P, V, T and n (the number of moles) have known values, then a gas is said to be in a definite state, meaning that all other physical properties of the gas are also defined. The relation between these state variables is known as an equation of state.
- An ideal gas is an imaginary gas that follows the gas laws and has 0 volume at 0 K i.e., the gas does not exist.

ORGANIC CHEMISTRY

Organic chemistry is defined as the study of hydrocarbons and their derivatives. Most atoms are only capable of forming small molecules. However one or two can form larger molecules.

Urea was the first organic compound prepared in laboratory. It was prepared by Wohler (1828) from inorganic compound i.e. ammonium cyanate.

Acetic acid was the first organic compound synthesized from the elements by **Kolbe**.

Functional group is responsible for the chemical properties of the molecules ex. OH is alcoholic group

Isomers Compounds having the same molecular formula but different structures, e.g. C_2H_6O can have the structure, i.e. CH_3OCH_3 (dimethyl ether) and C_2H_5OH (ethanol).

Hydrocarbons

These are the compounds of only carbon and hydrogen.

Saturated hydrocarbons They contain only single bonds. These are also called **alkanes** or **paraffins** and have general formula C_nH_{2n+2}. Methane is the first member of this group.

Unsaturated hydrocarbons They have general formula C_nH_{2n} for alkene and C_nH_{2n-2} for alkynes. These have atleast one double (=) or triple (≡) bond and are called **alkenes** and **alkynes** respectively.

Aromatic hydrocarbons They have ring structure with alternate double bonds and (4n + 2) πe^- (Huckel's rule) e.g. benzene.

Important Hydrocarbons and their Uses

Methane (CH_4) It is also known as marsh gas or damp fire. Natural gas contains mainly 90% methane along with ethane, propane, butane etc. Rice agriculture is a big source of atmospheric methane.

- It is the cause of occurrence of the explosions in mines.
- It is used as a fuel gas in making carbon black.

Biogas

Produced during decay of biomass in the absence of oxygen. Methane (75%) is the main constituent of biogas).

Ethane (C_2H_6)

Natural gas contains approx. 10% ethane. Its hexachloro derivative C_2CI_6 is used as an artificial camphor.

Butane (C_4H_{10})

It is the main constituent of LPG (liquefied petroleum gas).

Ethylene ($CH_2 = CH_2$)

In World war | (1914-18), it was used for the manufacturing of mustard gas (poisonous gas). It is used as an anesthetic for the preservation and artificial ripening of green fruits.

Acetylene (CH ≡ CH)

Benzene (C_6H_6)

It is the simplest aromatic hydrocarbon. It was discovered by Faraday in 1825. It is also used as a motor fuel under the name benzol.

Toluene ($C_6H_5CH_3$)

It is used as a commercial solvent in the manufacturing of explosive (TNT), drugs (chloramines-T) and dyestuffs. Used in the manufacturing of saccharin and printing inks. toluene is used as antifreeze.

Naphthalene ($C_{10}H_8$)

It is used for preventing moths in clothes, as an insecticide.

Halogen Derivatives of Hydrocarbons

Chloroform ($CHCI_3$)

- It was discovered by **Liebig** in 1831).
- It is stored in closed dark coloured bottles completely filled because it is oxidized by air in the presence of sunlight to an extremely poisonous gas phosgene ($COCI_2$).
- It reacts with conc. HNO_3 and form chloropicrin ($CI_3C - NO_2$). Chloropicrin is an insecticide and also used as poisonous gas at the time of war.
- The major use of chloroform today is in the production of the Freon refrigerant, R-22.

Iodoform (CHI_3)

It is used as an antiseptic due to liberation of free iodine.

Carbon tetrachloride (CCI_4)

used as a fire extinguishers under the name pyrene.

Dichloro diphenyl trichloro ethane (DDT)

It was the first chlorinated organic insecticides and originally prepared in 1873.

Alcohols

Methyl alcohol (CH_3OH)

- It is also known as wood spirit or wood naphtha.
- Methyl alcohol is poisonous in nature and when taken internally it can cause blindness and even death.
- It is used for denaturing alcohol (methylated spirit is denatured ethyl alcohol).

Ethyl alcohol (C_2H_5OH)

It is simply known as alcohol, spirit of wine or grain alcohol.

Glycerol $(CH_2OH.CHOH.CH_2OH)$

- It is an important trihydric alcohol known as glycerine.
- It is sweet in taste and very hygroscopic in nature. It is used in the manufacturing of cosmetics and transparent soaps.

Phenol (C_6H_5OH)

It is a monohydric benzene derivative. It is commonly known as carbolic acid or benzenol.

Methyl isocyanate (CH_3NCO)

Leakage of this gas is responsible for Bhopal gas tragedy.

Coal

- It is believed that is was formed by (carbonization). Different varieties of coal are anthracite (90% carbon), bituminous (70% carbon), lignite (40% carbon) and peat (10-15% carbon).
- On heating at 1270-1675 K in the absence of air, coal decomposes and gives the following products.
- **Coke** is the solid residue left after the distillation.
- **Coal tar** It is a mixture of about 700 substances.
- Now-a-days bitumen, a petroleum product, is used in place of coal tar for metalling the roads.
- The most significant characteristics of Indian coal are its high ash content, entrained gasifires and low sulphur content.
- The process of separation of various constituents/ fractions of petroleum is known as **refining**.
- **Knocking -** In a petrol engine, vapours of petrol and air are first compressed to a small volume and then ignited by a spark. If the quality of petrol is not good, it leads to the pre-ignition of fuel in the cylinder. This gives rise to a metallic sound known as knocking. Tetraethyl lead (TEL) and Benzene – Toluene – Xylene (BTX) are common antiknock compounds.
- **Octane number -** The antiknocking property of petrol is measured in terms of octane number. Higher the octane number, better is the quality of fuel. Gasoline used in automobiles has an octane number 80 or higher while in aeroplane, it has an octane number 100 or over higher.

Fuels:

- **Producer gas** is a mixture of carbon monoxide and nitrogen. Water gas in mixture of carbon monoxide and hydrogen.
- **Coal gas** is a mixture of hydrogen, methane, carbon monoxide, ethane, acetylene, carbon dioxide, nitrogen and oxygen.
- **Oil gas** and petrol gas is a mixture of methane, ethylene and acetylene etc., and is obtained by cracking of kerosene.
- **LPG** (Liquefied Petroleum Gas) the mixtures of hydrocarbons such as propane, propene, n-butane, isobutene and various butane with small amount of ethane.The major sources of LPG are natural gas.
- **CNG** (Compressed Natural Gas) It is highly compressed from of natural gas, octane rating of CNG is 130.
- **Gasohol+** It is a mixture of ethyl alcohol (10%) and petrol (90%).

Flame:

It is the hot part of fire and has three parts.

- **Innermost region of flame** It is black because of the presence of unburned carbon particles.
- **Middle region** It is yellow luminous due to partial combustion of fuel.
- **Outermost region** It is blue (non-luminous) due to complete combustion of fuel. It is the hottest part of flame and is used by the Goldsmith to heat the gold.

Rocket Fuel:

- The fuel used in rockets is called rocket propellant.
- **Liquid propellants** are alcohol, liquid hydrogen, liquid ammonia (NH_3), kerosene oil etc.
- **Solid propellants** are polybutadiene and acrylic acid used along with oxidizers such as aluminium per chlorate, nitrate or chlorate.

BIOLOGY

CELL

Cell: It is the basic structural unit of life.
Cells were first **discovered** by **Robert Hooke.**
Note: The smallest cell is 0.1 to 0.5 micrometre in bacteria. The largest cell measuring 170 mm ×130 mm, is the egg of an ostrich.
Amoeba acquires its food through **endocytosis.**

1. **Prokaryotes cells -** cells that have no defined nucleus
   Eg: Bacteria & Blue-green Algae
2. **Eukaryote -** cells which have definite nucleus
   Eg: Other than Bacteria & Blue-green Algae

Compounds called **proteins** and **phospholipids** make up most of the cell membrane.

Diffusion-It is a process of movements of substance from a region of high concentration to a region where its concentration is low. Water also obeys the law of diffusion.
Eg: Substances like Co_2 and O_2 can move across the cell membranes by a process called **diffusion**.

Osmosis: The movement of water molecules is called **osmosis**. Osmosis is a special case of diffusion through a selectively permeable membrane.

Types of Osmosis:

1. **Hypotonic:** more water will come into the cell than will leave. The cell is likely to swell up.
2. **Isotonic:** the amount going in is the same as the amount going out of the cell.The cell will stay the same size.
3. **Hypertonic:** more water leaves the cell than enters it. Therefore the cell will shrink.

When a living plant cell loses water through osmosis there is shrinkage or contraction of the contents of the cell away from the cell wall. This phenomenon is known as **plasmolysis.**

Cytoplasm : It is the fluid that fills a cell. Scientists used to call the fluid protoplasm.

Ribosomes : It synthesis protein, and Endoplasmic reticulum sent these protein in various part of the cell. Whereas Smooth Endoplasmic reticulum helps in the manufacture of fats.

Functions of these proteins and fats:

- Protein and fat (lipid) help in building the cell membranes. This process is known as **membranes biogenesis.**
- Smooth Endoplasmic reticulum plays a crucial role in detoxifying many poisons and drugs.

Golgi apparatus : It is another packaging organelle like the endoplasmic reticulum **functions:**

- It is the organelle that builds lysosomes (cells digestion machines).

Lysosomes(suicidal bag): It is a kind of waste disposal system of the cell.

Mitochondria(power house): The energy required for various chemical activities headed for life is released by mitochondria in the form of ATP (adenosine-tri-phosphate) molecules.

- **ATP is known as the energy currency of the cell.**
- Mitochondria are strange organelles in the sense that they have their own DNA and ribosomes, therefore mitochondria are able to make their own protein.
- Mitochondria is absent in bacteria and the red blood cells of mammals and higher animals.

Centrioles: centrioles are concerned with cell division. It initiates cell division.

Plastids: These are present only in plant cells.
Types of plastids:-

- **Chromoplast**(colour plastides) impart colour to flowers and fruits.
- **Leucoplasts**(white or colourless plastids) present in which starch, oils and protein are stored.
- **Plastids** are self-replicating. i.e. they have the power to divide, as they contain DNA, RNA and ribosomes.
- Plastides contains the pigment chlorophyll that is known as **chloroplast**. It is the site for photo synthesis.
  non –living parts with in the cell :-

Vacuoles: it is a fluid filled spaces enclosed by membranes. Its size in animal is small and in plant it is big.
Amino acids and sugars are stored in vacuoles.

Granules: It is not bounded by any membranes. It store fats, proteins and carbohydrates.

Cell nucleus: The cell nucleus acts like the brain of the cell. It helps control eating, movement
and reproduction. Not all cells have a nucleus.
The nucleus contain, the following components :
(a) Nuclear envelope
(b) Chromatin : When the cell is in resting state there is something called **chromatin** in the nucleus. Chromatin is made up of DNA, RNA and nucleus protein. DNA and RNA are the nucleus acids inside the cell. When the cell is going to divide, the chromatin become very compact. It condenses when the chromatin comes together we can see the chromosomes.
(c) Chromosomes: Chromosomes make organisms what they are. They carry all the information used to help a cell grow, thrive and reproduce.

- Chromosomes are made up of DNA.
- Segments of DNA in specific patterns are called **genes**.
- In prokaryotes, DNA floats in the cytoplasm in an area called the **nucleoid**.

- Chromosomes are not always visible. They usually sit around uncoiled and as loose shards called **chromation.**
- Chromosomes are usually found in pairs.
- Human Beings probably have 46 chromosomes (23 pairs).
- Peas only have 12, a dog has 78 chromosomes.
- The number of chromosomes is not related to the intelligence or complexity of the creature.

(d) Nucleolus: It is a dense spherical granule contained within the nucleus.It stores proteins.

Cell Division

Organisms grow and reduce through **cell division**.
There are two methods of replication **mitosis** and **meiosis**.
(a) Mitosis: It duplicates its DNA and the two new cells (daughter cells) have the same pieces and generic code. There are five steps in this process. You should remember the term PMATI. It breaks down to :
1. Prophase
2. Metaphase
3. Anaphase
4. Telophase
5. Interphase.

The main theme of **meiosis** is that there are two cell division. Mitosis has one division

Some important facts regarding cells :

- Nerve cells in animals are the longest cells.
- Smallest human cell is red blood cell.
- Largest human cell is female ovum.
- The single largest cell in the world is of an ostrich.
- The smallest cells are those of the mycoplasma.
- Every minute about 3 million cells in our body die.
- Sieve tube in plants and the mature mammalian red blood cells do not have a nucleus.
- The red blood cell carries respiratory gases.
- Sieve cells in plants transport nutrients in plants.
- The lysosomal enzymes of the sperm cells digest the limiting membranes of the ovum (egg). Thus the sperm is able to enter the ovum.
- During the transformation of tadpole into frog. The embryonic tissues like gills and tail are digested by the lysosome.
- Mitochondria contain DNA, hence capable of replication.
- Matrix is a transparent, homogenous semi-fluid substance. In its active state. It remains saturated with water.

TISSUE

Epithetical Tissue

(i) On the basis of cell layers
(a) When an epithelium has a single layer of cells it is called a simple epithelium.
(b) Where as a multiple tier of cells are known as stratified epithelium.
(ii) On the basis of simple shape of cells:

- **Cuboidal :** its occurrence is in kidney tubules, salivery glands, inner lining of the cheek. Its main function is to give mechanical strength.
- **Columnar :** its occurrence is in sweat gland, tear gland, salivary gland its main function is to gives mechanical strength concerned with secretions.
- **Squamous :** when it forms a living as that of blood vessels, it is called endothelium.
  Its main function is to protect the underlying parts from injury, entry of germs, etc.
- **Connective tissue :** Its main function is to bind and support other tissues.
  There are a few types of connective tissue.

Connective Tissue
Arelor
(i) Tendon
(ii) Ligament

Adipose Skeletal
(i) Bone
(ii) Cartilage

Fluid
(i) Blood
(ii) Lymph

A. Areolar tissue : It fills spaces inside organs found around muscles, blood vessels and nerves. Its main function is to joins skin to muscles, support internal organs, help in the repair of tissues. Whereas tendon's main function is to connect muscles to bones and ligament is connects bones to each other.

B. Adipose tissue : Its occurrence is below skin, between internal organs and in the yellow bone Marrow. Its main function is to storage of fat and to conserve heat.

C. Skeletal tissue : Bone & cartilage occurrences is in nose, epigotis and in intervertebral disc of mammals. Its main function is to provide support and flexibility to body part. Whereas bone protects internal delicate organs provides attachments for muscles, bone marrow makes blood cells.

D. Fluid tissue : Blood & Lymph blood transport O2 nutrients, hormones to tissues and organs. Whereas leucocytes fight diseases and platelets help in cloting of blood. Lymph transport nutrients into the heart and it also forms the defense system of the body.

Muscular Tissue

It is specialized for ability to contract muscle cells.
Types of Muscular tissue:
A. Skeletal muscle: It attached primarily to bones. Its main function is to provide the force for locomotion and all other voluntary movements of the body.

B. Cardiac muscle: It occurs only in the heart. The contraction and relaxation of the heart muscles help to pump the blood and distribute it to the various parts of the body.

C. Smooth muscle : It can be found in stomach, intestines, and blood vessels these muscles cause slow and prolonged contractions which are involuntary.

D. Nervous tissue: This tissue is specialized with a capability to conduct electrical impulses and convey information from one area of the body to another. Most of the nervous tissue (98%) is located in the central nervous system. The brain and spinal cord.

Types of Nervous Tissue

- neurons
- neuroglia

Important facts regarding animal tissue:-

- Muscles contain special protein called contractile protein. Which contract and relax to cause
- Fat storing adipose tissue is found below the skin and between internal organs.
- Two bones are connected to each other by a tissue called ligament. This tissue is very elastic.
- The skin, the living of the mouth, the living blood vessels, kidney tubules are all made up of epithelial tissue.
- Voluntary muscles and cardiac muscles are richly supplied with blood whereas involuntary muscles are poorly supplied with blood.

MUSCULAR AND SKELETAL SYSTEM

Skeletal Systems of Various Animals

Skeletons are either a fluid-filled body cavity, exoskeletons, or internal skeletons.

Note : Spiders use a combination of an exoskeleton for protection and fluid pressure for movement.

- Sharks, and rays have skeletons composed entirely of cartilage; other vertebrates have an embryonic cartilage skeleton progressively replaced by bone as they mature and develop.
- Some areas of the human body, however, retain cartilage in the adult: in joints and flexible structures such as the ribs, trachea, nose and ears.
- The upper bones of the limbs are single: humerus (arm) and femur (leg).
- Below a joint (elbow or knee), both limbs have a pair of bones (radius and ulna in the arms; tibia and fibula in legs) that connect to another joint (wrist or ankle).
- The carpals makeup the wrist joint; the tarsals are in the ankle joint.

Bone

- Bones have cells embedded in a mineralized (calcium) matrix and collagen fibers.
  The spongy bone of the femur, humerus, and sternum contains red marrow, in which stem cells reproduce and form the cellular components of the blood and immune system. Yellow marrow, at the center of these bones, is used to store fats. The outer layer of the bones is known as the periosteum.
- When fractures occur, the pain is carried to the brain by nerves running through the periosteum.

Skeletal Muscle Systems

When one muscle flexes (or contracts) the other relaxes, a process known as **antagonism**.

Muscles have both electrical and chemical activity.

Contraction of Non-muscular Cells

- Some fish have modified muscles that discharge electricity. These fish have electric organs consisting of modified muscles known as electroplates. The South American electric eel has more than 6000 plates arranged into 70 columns. Maximum discharge is 100 watts.

THE NERVOUS SYSTEM

- The Central Nervous System (CNS) includes the brain and spinal cord.
- The Peripheral Nervous System (PNS) connects the CNS to other parts of the body, and is composed of nerves(bundles of neurons)

The Neuron

Nervous tissue is composed of two main cell types: neurons and glial cells. Neurons transmit nerve messages. Glial cells are in direct contact with neurons and often surround them.

The neuron is the functional unit of the nervous system. Humans have about 100 billion neurons in their brain alone! While variable in size and shape,

Functions of the three parts of a neuron:

- **Axon:** It conducts messages away from the cell body.
- **Dendrite**: It receives information from axon of another cell and conducts the messages towards the cell body.
- **Cell body**: It contains nucleus, mitochondria, and other organelles. It is mainly concerned with the maintenance and growth.

SYNAPSES

The junction between a nerve cell and another cell is called a synapse.

The space between two cells is known as the synaptic cleft.

- The function between two neurons is called a 'ganglion'.

HUMAN EYE

The human eye is like a camera. Its lens system forms an image on a light-sensitive screen called the retina.

The eyeball is approximately spherical in shape with a diameter of about 2.3 cm.

The eye lens forms an inverted real image of the object on the retina.

RETINA -> The retina is a delicate membrane having enormous number of light-sensitive cells.

CORNEA -> Light enters the eye through a thin membrane called the cornea.It is the eye's outermost layer. It is the clear, dome-shaped surface that covers the front of the eye. It plays an important role in focusing your vision.

PUPIL -> The pupil is a hole located in the centre of the iris of the eye that allows light to strike the retina. It appears black because light rays entering the pupil are either absorbed by the tissues inside the eye directly, or absorbed after diffuse reflections within the eye. The pupil regulates and controls the amount of light entering the eye.
IRIS -> It is a dark muscular diaphragm that controls the size of the pupil and thus the amount of light reaching the retina.
CILIARY MUSCLE -> The ciliary muscle is a ring of smooth muscle in the eye's middle layer that controls accommodation for viewing objects at varying distances and regulates the flow of aqueous humour into Schlemm's canal. It changes the shape of the lens within the eye, not the size of the pupil.

The light-sensitive cells get activated upon illumination and generate electrical signals. These signals are sent to the brain via the optic nerves. The brain interprets these signals, and finally, processes the information so that we perceive objects as they are.

Note: When the light is very bright, the iris contracts the pupil to allow less light to enter the eye. However, in dim light the iris expands the pupil to allow more light to enter the eye. Thus, the pupil opens completely through the relaxation of the iris.

A human being has a horizontal field of view of about 150° with one eye and of about 180° with two eyes.

HUMAN BRAIN

The brain is the most complex part of the human body. This three-pound organ is the seat of intelligence, interpreter of the senses, initiator of body movement, and controller of behavior.

The brain can be divided into three basic units:
- The forebrain,
- The midbrain, and
- The hindbrain

The **forebrain** is the largest and main thinking part of the brain. It has regions which receive sensory impulses from various receptors. Separate areas of the fore-brain are specialised for hearing, smell, sight and so on.
The **Midbrain** connects the forebrain to the hindbrain.
The **hindbrain** controls the body's vital functions such as respiration and heart rate.

➳CEREBRUM [Largest part of the human brain]
- It sits at the topmost part of the brain.
- It is the source of intellectual activities.
- It holds your memories, allows you to plan, enables you to imagine and think.
- It allows you to recognize friends, read books, and play games.
- It controls the voluntary motor actions.
- It is the seat of learning and memory.
- It is the site of sensory perceptions; like tactile and auditory perceptions.
- It is divided into two hemispheres; called cerebral hemispheres.

➳HYPOTHALAMUS
- It lies at the base of the cerebrum.
- It controls sleep and wake cycle (circadian rhythm) of the body.
- It also controls the urges for eating and drinking.
- It gets the adrenaline flowing during a test or job interview.

➳CEREBELLUM
- It lies below the cerebrum and at the back of the whole structure.
- It coordinates the motor functions.
- It is responsible for precision of voluntary actions and maintaining the posture and balance of the body.
- Example: When you are riding your bicycle; the perfect coordination between your pedaling and steering control is achieved by the cerebellum.

➳MEDULLA
- It forms the brain stem; along with the pons.
- It lies at the base of the brain and continues into the spinal cord.
- It controls various involuntary functions
- Example: heartbeat, respiration, size of the pupil, blood pressure, salivation and vomiting etc.

➳THALAMUS
- A major clearinghouse for information going to and from the spinal cord and the cerebrum.
- Cerebrospinal fluid (CSF) is a watery fluid that circulates through the brain's ventricles (cavities or hollow spaces) and around the surface of the brain and spinal cord.

THE ENDOCRINE SYSTEM

Hormones
The endocrine system is a collection of glands that secrete chemical messages we call hormones. These signals are passed through the blood to arrive at a target organ, which has cells possessing the appropriate receptor.
Exocrine glands (not part of the endocrine system) secrete products that are passed outside the body. Sweat glands,

salivary glands, and digestive glands are examples of exocrine glands.
Hormones are grouped into three classes based on their structure:
1. steroids 2. Peptides 3. amines

The Nervous and Endocrine Systems
The pituitary gland (often called the master gland) is located in a small bony cavity at the base
of the brain. A stalk links the pituitary to the hypothalamus, which controls release of pituitary hormones. The pituitary gland has two lobes: the anterior and posterior lobes.
Too little or two much GH(Growth hormone) can cause **dwarfism or gigantism**, respectively.
Prolactin is secreted near the end of pregnancy and prepares the breasts for milk production.

II. THE POSTERIOR PITUITARY
ADH(Antidiuretic hormone) controls water balance in the body and blood pressure. Oxytocin is a small peptide hormone that stimulates uterine contractions during childbirth.
Thyroid secretion is usually higher in winter than in summer.
Endocrines: The Postal System of Communication and Co-Ordination

- Hormones are chemical substances manufactured by organs called endocrine glands or ductless glands. **Ductless glands** are also sometimes called 'exocrine glands'.

ENDOCRINE GLAND OF THE BODY

Adrenal gland
The adrenal glands (also known as suprarenal glands) are endocrine glands that produce a variety of hormones including adrenaline.
They are found above the kidneys.

Hypothalamus
The hypothalamus is a portion of the brain that contains a number of small nuclei with a variety of functions.
Function: link the nervous system to the endocrine system via the pituitary gland.

Pituitary gland
It is an endocrine gland about the size of a pea and weighing 0.5 grams in humans.
Hormones secreted from the pituitary gland help control:

- growth,
- blood pressure,
- certain functions of the sex organs,
- metabolism,
- pregnancy,
- childbirth,
- nursing,
- water/salt concentration,
- temperature regulation
- pain relief.

Thyroid
The thyroid gland, or simply the thyroid is one of the **largest endocrine glands** in the body.
It is found in the interior neck, below the Adam's apple.

- It secretes two hormones: triodothyro (T3) and tetraiodothysonine (T4), are called tyrosine. Both these hormones contain iodine.
- Hypothyroidism (hypo, 'under')–diminished thyroid activity. Hypothyroi-dism in childhood gives rise to a conditions called cretinism.

It controls

- **rate of use of energy sources, protein synthesis, controls the body's sensitivity to other hormones.**

Goiter– is called enlargement of the thyroid gland. It manifests itself as a swelling in the neck.
A goiter may be associated with increased, normal or descreased activity of the thyroid gland.
Government of India launched the Universal salt iodisation programme in 1986.

Pancreas
The pancreas is a glandular organ in the digestive system and endocrine system of vertebrates.
In humans, it is located in the abdominal cavity behind the stomach.

It produce several important hormones

- including insulin,
- glucagon,
- somatostatin, and
- pancreatic polypeptide which circulate in the blood.

The pancreas is also a **digestive organ**, secreting pancreatic juice containing digestive enzymes that assist digestion and absorption of nutrients in the small intestine. These enzymes help to further **break down** the **carbohydrates, proteins, and lipids in the chyme**.

Reduction on the quantity of effective insulin gives rise to diabetes mellitus (diabetes, siphon, mellitus of honey) commonly called simply diabetes.

***Saliva* contain an enzyme called 'anylax' which breaks down the starch in food into maltose.**
Bite is an essential supplement to the recreations enzyme for digestion of fats.

LYMPHATIC SYSTEM AND IMMUNITY

The Lymphatic System

- The spleen serves as a reservoir for blood, and filters or purifies the blood and lymph fluid that flows through it.
- If the spleen is damaged or removed, the individual is more susceptible to infections.

Immunity

- **Antibodies:** Antibodies are a type of protein molecule known as **immunoglobulins**.

BLOOD

- Blood is a fluid connective tissue.
- The quantity of blood in the human's body is 7% of the total weight.
- pH value of blood is 7.4.
- There is an average of 5-6 litres of blood in human body.
- Female contains half litre of blood less in comparison to male.
- It also fights infection and regulates temperature.

Blood cells are produced in BONE MARROW

The main functions of blood are to transport oxygen, carbon dioxide, water, nutrients, hormones and waste around the body. Blood also fights infection and regulates temperature.
Blood has four components:

1. Plasma
2. Red blood cells
3. White blood cells
4. Platelets

PLASMA -> Liquid portion of Blood

- It constitutes for about 54% of our blood. 92% of it is water.
- maintaining a satisfactory blood pressure
- volume to supplying critical proteins for blood clotting and immunity.
- medium for exchange of vital minerals such as sodium and potassium
- helps to maintain a proper pH (acid-base) balance in the body, which is critical to cell function.

RED BLOOD CELLS -> Carry oxygen

- Red blood cells are disc-shaped cells containing haemoglobin,
- haemoglobin (haem=iron-containing)
- Haemoglobin enables the cells to pick up and deliver oxygen to all parts of the body, then pick up carbon dioxide and remove it from tissues.
- Its life span is from 20 days to 120 days and are then broken down into pigments called bilirubin and biliverdin in the liver.
- Its destruction takes place in liver & spleen. Therefore, liver is called grave of RBC.
- they are made in the bone marrow,
- they have no nucleus,
- N.B. oxyhaemoglobin =oxygen rich haemoglobin,
- deoxyhaemoglobin=low oxygen haemoglobin

WHITE BLOOD CELLS -> Defend Body (Fighter)

- White blood cells, also called leukocytes
- White cells are the body's primary defense against infection.
- They can move out of the blood stream and reach tissues to fight infection.
- They are essential for good health.
- Its life span is from 1 to 2 days.
- White blood cells have nuclei and are also made in the bone marrow.

PLATELETS-> Responsible for clotting
Platelets are the cells that circulate within our blood and bind together when they recognize damaged blood vessels.

Study of blood = HEMATOLOGY

THE CIRCULATORY SYSTEM

HUMAN HEART

The human heart is an organ that pumps blood throughout the body via the **circulatory system**, supplying oxygen and nutrients to the tissues and removing carbon dioxide and other wastes.

The human heart has four chambers:

- The right atrium and right ventricle together make up the "**right heart**,"
- the left atrium and left ventricle make up the "**left heart**."
- A wall of muscle called the **septum** separates the two sides of the heart.
- **Valves prevent backflow,** keeping the blood flowing in one direction through the heart.

A double-walled sac called the ***pericardium*** encases the heart, which serves to protect the heart and anchor it inside the chest.
Between the outer layer, the **parietal pericardium**, and the inner layer, the **serous pericardium**, runs pericardial fluid, which lubricates the heart during contractions and movements of the lungs and diaphragm.

The heart's outer wall consists of three layers:-

- The outermost wall layer, or **epicardium,** is the inner wall of the pericardium.
- The middle layer, or **myocardium,** contains the muscle that contracts.
- The inner layer, or **endocardium,** is the lining that contacts the blood.

The **sinoatrial node** produces the electrical pulses that drive heart contractions.

HUMAN HEART FUNCTION

The heart circulates blood through two pathways:

1. The pulmonary circuit

2. The systemic circuit

In the pulmonary circuit, deoxygenated blood leaves the right ventricle of the heart via the pulmonary artery and travels to the lungs, then returns as oxygenated blood to the left atrium of the heart via the **pulmonary vein.**

In the systemic circuit, oxygenated blood leaves the body via the left ventricle to the aorta, and from there enters the arteries and capillaries where it supplies the body's tissues with oxygen. Deoxygenated blood returns via veins to the **vena cava,** re-entering the heart's right atrium.

The ***cardiovascular system*** circulates blood from the heart to the lungs and around the body via blood vessels.

Blockage of any artery can cause a heart attack, or damage to the muscle of the heart. A heart attack is distinct from cardiac arrest, which is a sudden loss of heart function that usually occurs as a result of electrical disturbances of the heart rhythm.

The heart contains electrical "pacemaker" cells, which cause it to contract — producing a heartbeat.
The aorta is the main artery leaving the heart.
The pulmonary artery is the only artery that carries oxygen-poor blood.
The pulmonary artery carries deoxygenated blood to the lungs.
The veins have valves that prevent backflow of blood **Blood pressure.**

Important Points:

Aorta

The largest artery in the body. It carries oxygen-rich blood away from the heart to vessels that reach the rest of the body.

Atria

The chambers of the heart, to which the blood returns from the circulation.

Capillaries

The smallest of the body's blood vessels. Oxygen and glucose pass through capillary walls and enter the cells. Waste products such as carbon dioxide pass back from the cells into the blood through capillaries.

Cardiac Valves (Heart Valves)

Any of the four heart valves that regulate the flow of blood through the chambers of the heart.

Oxygenated Blood -> Oxygen-rich blood.

Deoxygenated Blood -> Oxygen-poor blood.

Heart Ventricles

The lower right and left chambers of the heart.

Interventricular Septum

Interventricular septum is the stout wall separating the lower chambers (the ventricles) of the heart from one another.

Lungs

One of a pair of organs in the chest that supplies the body with oxygen, and removes carbon dioxide from the body.

Myocardium

The muscular substance of the heart; the middle of the three layers forming the outer wall of the human heart.

Pulmonary Artery

The pulmonary artery and its branches deliver blood rich in carbon dioxide (and lacking in oxygen) to the capillaries that surround the air sacs.

Pulmonary Circulation

The circulation of the blood through the lungs.

Pulmonary Veins

The veins that return the oxygenated blood from the lungs to the left atrium of the heart.

Superior Vena Cava

The large vein that carries blood from the head, neck, arms, and chest to the heart.

Vena Cava

A large vein which returns blood from the head, neck and extremities to the heart.

Endothelium is the innermost layer of blood vessels that consists of just a single layer of cells.

Veins are blood vessels that carry blood to the heart in an even flow. They have thin walls large lumens and valves.

A pulse is the alternate contraction and relaxation of an artery as blood passes through it.

Blood pressure is the force blood exerts on the walls of blood vessels.

A sphygmomanometer is used for measuring blood pressure(normally 120/80 mmHg)

Atherosclerosis is the hardening of artery walls due to a build-up of fatty deposits.

Smoking causes heart rate and blood pressure to increase. Diet high in saturated fats increase blood pressure and atherosclerosis. Exercise helps lower blood pressure.

Blood Groupings

- Father of Blood Grouping : Karl Landsteiner
- He discovered A, B and O blood groups
- Decastello and Sturle discovered AB blood groups

RH factor

- It is a blood antigen found in RBC
- A person can be Rh+ or Rh- depending upon the presence of Rh factor in RBC
- Rh+ can receive blood from both Rh+ and Rh- but Rh- can receive blood only from Rh- only

Blood transfusion techniques was developed by Dr. James Blundell.

THE REPRODUCTIVE SYSTEM

- Asexual reproduction allows an organism to rapidly produce many offspring without the time and resources committed to courtship, finding a mate, and mating.
- The hydra produces buds; starfish can regenerate an entire body from a fragment of the original body.

Sexual Reproduction

- In sexual reproduction new individuals are produced by the fusion of haploid gametes to form a diploid zygote.
- Sperm are male gametes, ova (ovum singular) are female gametes.
- Meiosis produces cells that are genetically distinct from each other.
- Fertilization is the fusion of two such distinctive cells.

Human Reproduction and Development

- Gonads are sex organs that produce gametes. Male gonads are the testes, which produce sperm and male sex hormones. Female gonads are the ovaries, which produce eggs (ova) and female sex hormones.

The Male Reproductive System

- Sperm production begins at puberty and continues throughout life, with several hundred million sperm being produced each day. Once sperm form they move into the epididymis, where they mature and are stored.

External Genitals

- The female external genitals are collectively known as the vulva.

Sexually Transmitted Diseases

STDs can affect the sex partners, fetus, and newborn infants. STDs are grouped into three categories.

Category One

STDs that produce inflammation of the urethra, epididymis, cervix, or oviducts. Gonorrhea and chlamydia are the most common STDs in this category. Both diseases can be treated and cured with antibiotics, once diagnosed.

Category Two

STDs that produce sores on the external genitals. Genital herpes is the most common disease in this class. Symptoms of herpes can be treated by antiviral drugs, but the infection cannot be cured. Syphilis is a bacterially caused infection, and can, if left untreated, cause serious symptoms and death. However, the disease is curable with antibiotics.

Category Three

This class of STDs includes viral diseases that affect organ systems other than those of the reproductive system. AIDS and hepatitis B are in this category. Both can be spread by sexual contact or blood. Infectious individuals may appear symptom-free for years after infection.

The separation of intercourse from pregnancy uses methods blocking one of the three stages of reproduction

- release and transport of gametes
- fertilization
- implantation

PLANT REPRODUCTION

Flowers

Reproductive parts of the flower are the stamen (male, collectively termed the androecium) and carpel (often the carpel is referred to as the pistil, the female parts collectively termed the gynoecium).

Pollen

Pollen grains contain the male gametophyte (microgametophyte) phase of the plant. They are produced by meiosis of microspore mother cells that are located along the inner edge of the anther sacs (microsporangia).

Pollination

The transfer of pollen from the anther to the female stigma is termed pollination. This is accomplished by a variety of methods:

Entomophyly is the transfer of pollen by an insect.

Anemophyly is the transfer of pollen by wind.

Other pollinators include birds, bats, water, and Humans.

Double Fertilization

The process of pollination being accomplished, the pollen tube grows through the stigma and style toward the ovules in the ovary.

Fruit

The ovary wall, after fertilization has occurred, develops into a fruit. Fruits may be fleshy, hard, multiple or single.

Note:- Seeds germinate, and the embryo grows into the next generation sporophyte.

THE DIGESTIVE SYSTEM

Stages in the Digestive Process

1. MOVEMENT : propels food through the digestive system

2. SECRETION : release of digestive juices in response to a specific stimulus

3. DIGESTION : breakdown of food into molecular components small enough to cross the plasma membrane

4. ABSORPTION: passage of the molecules into the body's interior and their passage throughout the body

5. ELIMINATION: removal of undigested food and wastes

The human digestive system, is a coiled, muscular tube (6-9 meters long when fully extended) stretching from the mouth to the anus.

The Mouth and Pharynx

Chemical breakdown of starch by production of salivary amylase from the salivary glands into glucose. This mixture of food and saliva is then pushed into the pharynx and esophagus.

The STOMACH

Gastric juice in stomach contains:

- **hydrochloric acid(HCl),**
- **pepsinogen, and**
- **mucus**

Functions of Hydrochloric acid(HCl) :

- It kills microorganisms,
- It lowers the stomach pH to between 1.5 and 2.5.
- It lowers pH of the stomach so pepsin is activated.

Pepsinogen is an enzyme that starts protein digestion and controls the hydrolysis of proteins into peptides.

Chyme, the mix of acid and food in the stomach, leaves the stomach and enters the small intestine.

Alcohol and aspirin are absorbed through the stomach lining into the blood.

Epithelial cells secrete mucus that forms a protective barrier between the cells and the stomach acids.

ULCERS

Peptic ulcers result when these protective mechanisms fail.
Bleeding ulcers result when tissue damage is so severe that bleeding occurs into the stomach.
Perforated ulcers are life-threatening situations where a hole has formed in the stomach wall.
At least 90% of all peptic ulcers are caused by Helicobacter pylori.
Other factors, including stress and aspirin, can also produce ulcers.

THE SMALL INTESTINE

- The small intestine is the major site for digestion and absorption of nutrients.
- it is about 22 feet (6.7 meters) long.

Parts of small intestine:

1. **Duodenum**
2. **Jejunum**
3. **Ileum**

- Sugars and amino acids go into the bloodstream via capillaries in each villus.
- Glycerol and fatty acids go into the lymphatic system.
- Starch and glycogen are broken down into maltose by small intestine enzymes.
- **Maltose, sucrose, and lactose** are the main carbohydrates present in the small intestine; they are absorbed by the microvilli.
- Enzymes in the cells convert these disaccharides into monosaccharides that then leave the cell and enter the capillary.
- **Gluten enteropathy** is the inability to absorb gluten, a protein found in wheat.
- Fat digestion is usually completed by the time the food reaches the ileum (lower third) of the small intestine. Bile salts are in turn absorbed in the ileum and are recycled by the liver and gall bladder.

LIVER

The liver produces and sends bile to the small intestine via the hepatic duct.
Bile contains cholesterol, phospholipids, bilirubin, and a mix of salts.

In addition to digestive functions, the liver plays several other roles:
(1) detoxification of blood;
(2) synthesis of blood proteins;
(3) destruction of old erythrocytes and conversion of haemoglobin into a component of bile;
(4) production of bile;
(5) storage of glucose as glycogen, and its release when blood sugar levels drop; and
(6) production of urea from amino groups and ammonia.

GALL BLADDER

It **stores excess bile** for release at a later time.
We can live without our gall bladders, in fact many people have had theirs removed. The drawback, however, is a need to be aware of the amount of fats in the food they eat since the stored bile of the gall bladder is no longer available.
Glycogen is a polysaccharide made of chains of glucose molecules.
In plants starch stored in the form of glucose, while animals use glycogen for the same purpose.

Low glucose levels in the blood cause the release of hormones, such as glucagon, that travel to the liver and stimulate the breakdown of glycogen into glucose, which is then released into the blood(raising blood glucose levels).
When no glucose or glycogen is available, amino acids are converted into glucose in the liver.The process of deamination removes the amino groups from amino acids. Urea is formed and passed through the blood to the kidney for export from the body. Conversely, the hormone insulin promotes the take-up of glucose into liver cells and its formation into glycogen.

Liver Diseases Jaundice occurs when the characteristic yellow tint to the skin is caused by excess hemoglobin breakdown products in the blood, a sign that the liver is not properly functioning.
Hepatitis A, B, and C are all viral diseases that can cause liver damage.
Cirrhosis: Cirrhosis of the liver commonly occurs in alcoholics, who place the liver in a stress situation due to the amount of alcohol to be broken down. Cirrhosis can cause the liver to become unable to perform its biochemical functions. **Chemicals responsible for blood clotting are**

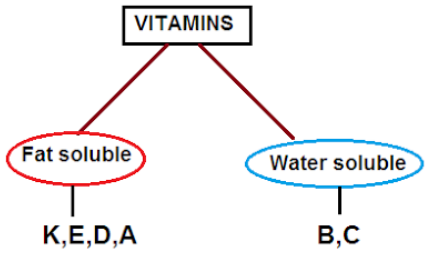
synthesized in the liver, as is albumin, the major protein in blood.

(D) The Large Intestine

The large intestine is made up by the colon, cecum, appendix, and rectum.

VITAMINS

Vitamins: Vitamins are organic molecules required for metabolic reactions. They usually cannot be made by the body and are needed in trace amounts. Vitamins may act as enzyme cofactors or coenzymes.



VITAMIN K (Phylloquinone)

SOURCE

Green leafy vegetables, soya beans. The human body can also produce Vitamin K through germs in the colon(part of small intestine).

FUNCTION

- Helps blood clotting, prevent over bleeding
- Maintains health of the liver

SYMPTOMS OF DEFICIENCY

Uncontrol bleeding from wounds due to clotting difficulty

SYMPTOMS OF EXCESS

Can lead to liver damage

VITAMIN E (Tocopherol)=Beauty Vitamin

It is also known as Antisterility Vitamin.

SOURCE

Green leafy vegetables, whole-wheat cereals, nuts, sprouts, egg yolk

FUNCTION

- Maintains normal conditions of cells, and healthy skin and tissues
- Protects red blood cells
- Antioxidation
- Enhance immunity

SYMPTOMS OF DEFICIENCY

New born infants: haemolytic anaemia

Adults: weakness

SYMPTOMS OF EXCESS

- Low thyroxine level
- Fertility Desease
- Headache, dizziness, fatigue
- Stomach discomfort, poor appetite

VITAMIN D (Calciferol)=(Sunhine Vitamin)

SOURCE

Egg yolk, liver, cod liver oil, fish. Our skins also produces Vitamin D when exposed to sunlight

FUNCTION

- Helps body absorb and utilize calcium and phosphorus, so as to maintain bones, teeth and brain healthy
- Maintains normal calcium level in blood

SYMPTOMS OF DEFICIENCY

Children: rickets

Adults: Osteomalacia, Osteoporosis

SYMPTOMS OF EXCESS

- Calcified cartilage
- High calcium level in the blood causes abnormal heart beat and damage to organs such as kidneys
- Vomiting, diarrhea
- Sore eyes
- Itchy skin

VITAMIN A (Retinol)

SOURCE

Dairy products, cod liver oil,liver, dark green and yellow vegetables and fruits

FUNCTION

- Maintains eye health
- Promotes growth and development, maintains healthy bones and teeth
- Enhances the protection and regeneration of cells and mucous membrane
- Maintains healthy respiratory and intestinal tracts
- Maintain healthy hair, nails and skin

SYMPTOMS OF DEFICIENCY

- Night blindness, dry eyes
- Dry skin
- Stomach discomfort
- Poor growth
- Weak bones and teeth

SYMPTOMS OF EXCESS

- Dry, scaly, peeling, and itchy skin, rash
- Hair loss
- Poor appetite, fatigue
- Vomiting, stomach discomfort
- Liver injury
- Headache, bone pain
- Nervousness, irritability

VITAMIN B

VITAMIN B1 (Thymine)

SOURCE

sprouts, yeast

Desease
Beri-beri

VITAMIN B2 (Ryboflabin)
SOURCE
sprout, present in cow's milk(yellowish)
Desease
Cheilosis, ulceration

VITAMIN B6 (Pyridoxine)
FUNCTION
It is responsible for rememeber dreams.
SYMPTOMS OF DEFICIENCY
Anaemia
Nervousness, insomnia, depression
Muscle cramps

VITAMIN C (Ascorbic acid)
SOURCE
Citrus fruits (orange, grapefruit, lemon), strawberry, black current, kiwi fruit, tomato, green leafy vegetables, green pepper

FUNCTION
- Helps synthesize collagen; promotes the growth and repair of cells, gum, teeth, blood vessels and bones
- Helps healing after operation and injury
- Helps calcium and iron absorption
- Enhances immunity

SYMPTOMS OF DEFICIENCY
- Scurvy
- Gum
- inflammation and bleeding, fall of teeth
- Susceptibility to skin bleeding, burst of capillary vessels
- Weakness, fatigue
- Bone pain, swollen and aching joints

SYMPTOMS OF EXCESS
- Abdominal pain
- Diarrhea
- Kidney stone

In smokers and drinkers vitamin C is absent.

TYPES OF VITAMINS:

Vitamin	Chemical Name	Food Sources	Deficiency Diseases
A	Retinol	Milk, eggs, fish, butter, cheese and liver.	Night blindness, Skin dryness.
B1	Thiamine	Legumes, whole grain, nuts.	Beri-beri.
B2	Riboflavin	Egg, milk, cheese, nuts, bread products.	Inflammation of tongue, sores in the corners of the mouth.
B3	Niacin or Nicotinic acid	Meat, fish, pea nuts, whole grain.	Skin disease, diarrhoea, depression, dementia.
B5	Pantothenic acid	Eggs, liver, dairy products.	Fatigue, muscle cramp. Pellagra
B6	Pyridoxine	Organ meats, cereals, corn.	Anaemia, kidney stones, nausea, depression.
B12	Cyanocobalamin	Meat, fish.	pale skin, constipation, fatigue.
C	Ascorbic acid	Oranges, tomatoes, sweet and white potatoes.	Scurvy, anaemia, ability to fight infections decreases.
D	Calciferol	Direct sunlight, fish oils, eggs.	Rickets, osteomalacia.
E	Tocopherol	Vegetable oils, olives, tomatoes, almonds, meat, eggs.	Neurological problems, problems of reproductive system.
K	Phylloquinone or Naphthoquinone	Soyabeans, green leafy vegetables, dairy products, meat.	Failure to clot blood.

Minerals: Iron(for hemoglobin), iodine (for thyroxin), calcium (for bones), and sodium (nerve message transmission) are examples of minerals.

Digestion in Animals Facts from NCERT
- Starfish feeds on animals covered by half shells of calcium carbonate.
- The saliva breakdown the starch into sugar.
- Liver situated in the upper part of the abdomen on the right side. It is the largest gland in the body.
- In the process of digestion carbohydrates get broken down into simple sugars such as glucose. Fats into fatty acid and glycerol. Proteins into amino acid.
- The grass is rich in cellulose a type of carbohydrates human cannot digest cellulose.
- Amoeba is a microscopic single celled organism found in pond water. When it sense food, it pushes out one or

more finger like projection (pseudopodia) around the food particles and engulf it and then the food becomes trapped in a food vacuole.

THE EXCRETORY SYSTEM

Excretory Systems in Various Animals

Components of this system in vertebrates include the kidneys, liver, lungs, and skin.

Water and Salt Balance

The excretory system is responsible for regulating water balance in various body fluids.

Osmoregulation refers to the state aquatic animals are in: they are surrounded by freshwater
and must constantly deal with the influx of water.

Excretory System Functions

1. Collect water and filter body fluids.
2. Remove and concentrate waste products from body fluids and return other substances to body fluids as necessary for homeostasis.
3. Eliminate excretory products from the body.

The Human Excretory System

The urinary system is made-up of the kidneys, ureters, bladder, and urethra. The nephron, an evolutionary modification of the nephridium, is the kidney's functional unit.

The nephron has three functions:

1. Glomerular filtration of water and solutes from the blood.
2. Tubular reabsorption of water and conserved molecules back into the blood.
3. Tubular secretion of ions and other waste products from surrounding capillaries into the distal tubule.

Kidney Stones

In some cases, excess wastes crystallize as kidney stones. They grow and can become a painful irritant that may require surgery or ultrasound treatments.

Kidney Functions

1. Maintain volume of extracellular fluid
2. Maintain ionic balance in extracellular fluid
3. Maintain pH and osmotic concentration of the extracellular fluid.
4. Excrete toxic metabolic by-products such as urea, ammonia, and uric acid.

Kidneys, The Fascinating Filters

Nephron is the filteration unit of kidney.

- Excessive eating (polyphagia), excessive drinking (polydipsia) and too much of urine (polyusia) are three cardinal symptoms of diabetes. The 'hypothesis' produces a chemical substance called 'antidivretic hormone (ADH).
- The Adrenal gland maintains the regulating salt in the body and is located in an organ lying just over the kidney. As soon as the salt (sodium) concentration become just a little less than normal, it release into the blood stream a substance called 'aldosterone'.
- Renal transplantation or dialysis (artificial kidney) are the supportive measure when the damage to kidney reaches a certain point.

Hormone Control of Water and Salt

Water reabsorption is controlled by the antidiuretic hormone (ADH) in negative feedback.

ADH is released from the pituitary gland in the brain. Dropping levels of fluid in the blood signal the hypothalamus to cause the pituitary to release ADH into the blood. ADH acts to increase water absorption in the kidneys.

Aldosterone, a hormone secreted by the kidneys, regulates the transfer of sodium from the nephron to the blood. When sodium levels in the blood fall, aldosterone is released into the blood, causing more sodium to pass from the nephron to the blood. This causes water to flow into the blood by osmosis. Renin is released into the blood to control aldosterone.

PHOTOSYNTHESIS

- The raw materials of photosynthesis, water and carbon dioxide, enter the
- cells of the leaf, and the products of photosynthesis, sugar and oxygen,leave the leaf.
- Water enters the root and is transported up to the leaves through specialized plant cells known as xylem.
- Carbon dioxide cannot pass through the protective waxy layer covering the leaf (cuticle), but it can enter the leaf through an opening flanked by two guard cells.
- Likewise, oxygen produced during photosynthesis can only pass out of the leaf through the opened stomata.

Chlorophyll and Accessory Pigments

- Chlorophyll, the green pigment common to all photosynthetic cells,absorbs all wavelengths of visible light except green, which it reflects to bedetected by our eyes.
- Black pigments absorb all of the wavelengths that strike them.

DIVERSITY IN LIVING ORGANISMS

Differentiation in Plants

Thallophyta

- The plants in this group are commonly called algae. These plants are predominantly aquatic.
  E.g. : Spirogyra, cladophora and chara.

Bryophyte

- These are called the amphibians of the plant kingdom. There is no specialized tissue for the conduction of water and other substances from one past of the plant body to another.

E.g. : moss (fumaria) and marchantia

Pteridopheysta

- In this group plant body is differentiated into roots, stem and leaves and has specialized tissue for the conduction of water and other substances from one plant of the plant body to another. Eg- marsilea, ferns, and horse tails.

Gymnosperms

- The plant of this group bear naked seeds and one usually perennial and evergreen and woody. Eg- pines such as deodar.

Angiosperms

- The seeds develop inside an organ which is modified to become a fruit. These are also called flowering plants.
- Plant embryos in seeds have structures called cotyledons. Cotyledons are called seed leaves because in many instances they emerge and become green the seed germinates.
- Plants with seeds having a single cotyledon are called monocotyledons or monocots. Eg- paphiopedilum.
- Plants with seeds having two cotyledons are called dicots. E.g-Egipomoce.

Pisces

- These are fish. They are cold blooded and their hearts have only two chambers unlike the four that human have.
- Some with skeletons made entirely of cartilage, such as shark.
- Some with skeleton made of both bones and cartilages such as tuna or rohu.

Amphibian

- They have mucus glands in the skin and a three chambered heart. Respiration is through either gills or lungs.
  Eg- frogs, toades, and salamanders.

Reptilia

- These animals are cold blooded have scales and breathe through lungs. While most of them have a three chamber heart while crocodile have four heart chambers. Eg- snakes, turtles, lizards and crocodiles.

Aves

- These are warm blooded animals and have a four chambered heart. They lay eggs. They breathe through lungs. All birds fall in this category.

Mammalia

- They are warm blooded animals with four chambered hearts.
- They have mammary glands for the production of milk to nourish their young. They produce live young ones.
- However a few of them like platypus and the echidna(Spiny Anteater) lay eggs.

MICRO ORGANISMS: FRIEND AND FOE

Micro organisms are classified into four major groups. These groups are bacteria, fungi, protozoa and algae.

- **Viruses :** They reproduce only inside the cells of the host organisms which may be bacterium, plants or animal.
- Common cold, influenza and most coughs are caused by viruses.
- Serious diseases like polio and chickepox are also caused by viruses.
- Micro organisms may be single celled like bacteria, Some algae and protozoa. Multicellular such as algae and fungi.
- Micro organisms like amoeba can live alone, while fungi and bacteria may live in colonies.

Advantages of Micro Organisms

- Making of curd and breed:-milk is turned into curd by bacteria. The bacterium "lactobacillus" promotes the formation of curd.
- Yeast reproduces rapidly and produces CO_2 during respiration. Bubbles of the gas fill the dough and increase its volume.
- Yeast is used for commercial production of alcohol and wine. For this purpose yeast is grown as natural sugars present in grains like barley, wheat, rice, crushed fruit juice etc.
- This process of conversion of sugar into alcohol is known as fermentation. Lewis Pasteur discovered fermentation.

Medicinal Use of Micro Organisms

- The medicine which kills or stops the growth of diseases causing microorganism is called antibiotics.
- Streptomycin, tetracycline and erythromycin are some of the commonly known antibiotics. Which are made from fungi and bacteria.
- Alexander Fleming discovered penicillin.
- Antibiotics are not effective against cold and flu as these are caused by virus.

Vaccine

- Edward Jenner discovered the vaccine for small pox.

Harmful Microorganisms

- Disease-causing microorganisms are called pathogens.
- Microbial diseases that can spread from an infected person to a healthy person through air water, food, or physical contact are called communicable diseases. i.e.- cholera, common cold, chicken pox and TB.
- Female anopheles mosquito which carries the parasite of malaria.
- Female aedes mosquito acts as carrier of dengu virus.
- Robert Koch discovered the bacteria (bacillus anthracis) which causes anthrax disease.

Common Methods of Preserving Food in our Homes

- **Chemical method :** salt and edible oils are the common chemical generally used.
- Sodium benzoate and sodium metabisulphite are common preservatives. These are also used in the Jams and squashes to check their spoilage.

Preservation by sugar :

- Sugar reduces the moisture context which inhibits the growth of bacteria which spoil food.
- Use of oil and vinegar prevents spoilage of pickles become bacteria cannot live in such an environment.
- Pasteurized milk : the milk is heated to about 70°C for 15 to 30 seconds and then suddenly chilled and stored.
- This process was discovered by Louis Pasteur. It is called **pasteurisation.**

SOME IMPORTANT TABLES

Important Facts About Human Body:

Largest and strongest Bone in the body:	Femur (thigh bone)
Smallest Bone in the body:	Stapes in ear
Volume of Blood in the body:	6 litres (in 70 kg body)
Number of Red Blood Cells(R.B.C.):	1. In male: 5 to 6 million/cubic mm
	2. In female: 4 to 5 million/cubic mm
Life span of Red Blood Cells(R.B.C.):	100 to 120 days
Life span of White Blood Cell(W.B.C.):	3-4 days
Time taken by R.B.C. to complete one cycle of circulation:	20 seconds
Other name of Red Blood Cell (R.B.C.):	Erythrocytes
Largest White Blood Cells:	Monocytes
Smallest White Blood Cells:	Lymphocyte
Who discovered Blood Group:	Karl Landsteiner
Blood Platelets count:	150,000 - 400,000 platelets per micro litre
Haemoglobin (Hb):	1. In male: 14-15 gm/100 c.c. of blood
	2. In female: 11-14 gm/100 c.c. of blood
Hb content in body:	500-700 gm
pH of Urine:	6.5-8
pH of Blood:	7.36-7.41
Volume of Semen:	2-5 ml/ejaculation
Normal Sperm Count:	250-400 million/ejaculation
Menstrual cycle:	28 days
Menopause age:	45-50 years
Blood clotting time:	3-5 minutes
Weight of Brain:	1300-1400 gm in human adult
Normal Blood Pressure (B.P.):	120/80 mm Hg
Universal blood donor:	O
Universal blood recipient:	AB
Average body weight:	70 kg
Normal body temperature:	37 degree Celsius
Breathing Rate at rest:	12-16/minute
Number of Spinal Nerves:	31 pairs
Largest Endocrine Gland:	Thyroid gland
Normal Heart Beat at rest:	72 beats per minute
Largest Gland:	Liver
Largest Muscle in the body:	Gluteus Maximus or Buttock Muscle
Smallest Muscle in the body:	Stapedius
Largest Artery:	Aorta
Largest Vein:	Inferior Vena Cava
Largest and longest Nerve:	Sciatic Nerve
Longest Cell:	Neurons (nerve cells)
Minimum distance for proper vision:	25 cm
Pulse rate:	72 per minute
Thinnest Skin:	Eyelids
Weight of Heart:	200-300 gm

Common Drugs and Their Usage:

Drugs/Medicine	Use
Anaesthetics	It is a drug that induces insensitivity to pain.
Antiflatulent	It is a drug that reduces intestinal gas
Antipyretics	It is a drug used to lower body temperature.
Analgesics	It is a drug that is used to prevent or relieve pain. Eg. Aspirin.
Antibiotics	It is a drug that inhibits the growth of or destroys micro-organisms. Eg. Penicillin.
Antihistamines	It is a drug used to relieve symptoms of cold and allergies.
Antispasmodic	It is a drug used to relieve spasm of involuntary muscle usually in stomach.
Antacid	It is a drug used for preventing or

	correcting acidity, especially in the stomach.
Diuretics	It is a drug that promotes the production of urine.
Laxative	It is a drug used to provide relief in constitpation.

TYPES OF DISEASES
List of Diseases caused by Virus, Bacteria, Protozoa and Worm:

Disease caused by Viruses:

1. Chicken pox - It is caused by Varicella-zoster virus.
2. Small Pox - It is caused by Variola virus.
3. Common Cold -It is caused by Rhinovirus.
4. AIDS (Acquired Immunono Deficiency Syndrome) - It is caused by Human Immunodeficiency Virus (HIV).
5. Measles -It is caused by Measles virus.
6. Mumps -It is caused by Mumps virus.
7. Rabies - It is caused by Rabies virus (Rhabdoviridae family).
8. Dengue fever -It is caused by Dengue virus.
9. Viral encephalitis - It is an inflammation of the brain. It is caused by rabies virus, Herpessimplex, polio virus, measles virus, and JC virus.

Disease caused by Bacteria:

1. Whooping Cough - It is caused by a bacterium called Bordetella pertussis.
2.Diphtheria - It is caused by Corynebacteriumdiphtheriae.
3. Cholera - It is caused by Vibrio cholerae.
4. Leprosy - It is caused by Mycobacterium leprae.
5. Pneumonia-It is caused by Streptococcus pneumoniae.
6. Tetanus -It is caused by Clostridium tetani.
7. Typhoid - It is caused by Salmonella typhi.
8. Tuberculosis -It is caused by Mycobacterium tuberculosis.
9. Plague - It is caused by Yersinia pestis.

DISEASE CAUSED BY PROTOZOANS:

1. Malaria	It is spread by Anopheles mosquitoes. The Plasmodium parasite that causes malaria is neither a virus nor a bacteria	it is a single	celled parasite that multiplies in red blood cells of humans.
2.Amoebic dysentery	It is caused by Entamoebahistolytica.		
3.Sleeping sickness	It is caused by Trypanosomabrucei.		
4. Kala azar	It is caused by Leishmaniadonovani.		

DISEASE CAUSED BY WORMS:

1. Tapeworn	They are intestinal parasites. It cannot live on its own. It survives within the intestine of an animal including human.	
2. Filariasis	It is caused by thread	like filarial nematode worms. Most cases of filaria are caused by the parasite known as Wuchereriabancrofti.
3. Pinworm	It is caused by small, thin, white roundworm called Enterobiusvermicularis.	

VITAMINS AND MINERAL DEFICIENCY DISEASES:

1. Anaemia	It is caused due to deficiency of mineral Iron.
2. Ariboflavinosis	It is caused due to deficiency of Vitamin B2.
3. BeriBeri	It is caused due to deficiency of Vitamin B.
4. Goitre	It is caused due to deficiency of Iodine.
5. Impaired clotting of the blood	It is caused due to deficiency of Vitamin K.
6. Kwashiorkor	It is caused due to deficiency of Protein.
7. Night Blindness	It is caused due to deficiency of Vitamin A.
8. Osteoporosis	It is caused due to deficiency of mineral Calcium.
9. Rickets	It is caused due to deficiency of Vitamin D.
10. Scurvy	It is caused due to deficiency of Vitamin C.

COMMON HUMAN DISEASES AND AFFECTED BODY PART:

Disease	Affected Body Part
AIDS	Immune system of the body
Arthritis	Joints
Asthma	Bronchial muscles
Bronchitis	Lungs
Carditis	Heart
Cataract	Eye
Cystitis	Bladder
Colitis	Intestine
Conjunctivitis	Eye
Dermatitis	Skin
Diabetes	Pancreas and blood

Diphtheria	Throat
Eczema	Skin
Goitre	Thyroid gland
Glossitis	Tongue
Glaucoma	Eye
Gastritis	Stomach
Hepatitis	Liver
Jaundice	Liver
Malaria	Spleen
Meningitis	Brain and spinal cord
Myelitis	Spinal cord
Neuritis	Nerves
Otitis	Ear
Osteomyelitis	Bones
Paralysis	Nerves and limb
Pyorrhoea	Teeth
Peritonitis	Abdomen
Pneumonia	Lungs
Rhinitis	Nose
Rheumatism	Joints
Tuberculosis	Lungs
Tonsillitis	Tonsils
Trachoma	Eye

BLOOD GROUP AND ITS CLASSIFICATION :
K.Landsteiner : Classified human beings (1900) in four groups on the basis of the reaction of their blood:A,B,AB and O.

Blood group	*Carries antigen*	*Carries antibody*	*Can donate blood to*	*Can receive blood from*
A	**A**	**B**	**A,AB**	**A,O**
B	**B**	**A**	**B,AB**	**B,O**
AB	**A,B**	**None**	**Only AB**	**Universal Accepter**
O	**None**	**A,B**	**Universal donor**	**Only O**

ECONOMICS CAPSULE 2017 for SSC CGL & Other Exams

INTRODUCTION

Economics: The science which studies human behaviour as a relationship between ends and scarce means which have alternative uses".
Macroeconomics: It is the study of economic system as a whole. It studies broad aggregates like national income, employment and trade.
Micro Economics: It is a study of behaviour of individual units of an economy such as individual consumer, producer etc.
Economy: An economy is a system by which people get their living.
Production Possibility Curve (PPC): PP curve shows all the possible combination of two goods that can be produced with the help of available resources and technology.
Marginal Opportunity Cost: MOC of a particular good along PPC is the amount of other good which is sacrificed for production of additional unit of another good.
Marginal Rate of Transformation: MRT is the ratio of units of one good sacrificed to produce one more unit of other good.

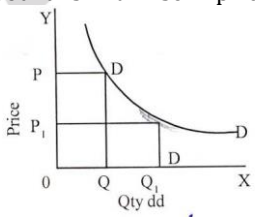
DEMAND Concepts

- **Demand:** Quantity of the commodity that a consumer is able and willing to purchase in a given period and at a given price.
- **Demand Schedule**: It is a tabular representation which shows the relationship between price of the commodity and quantity purchased.
- **Demand Curve**: It is a graphical representation of demand schedule.
- **Individual Demand**: Demand by an individual consumer.

Factors Affecting Individual Demand For a Commodity/ Determinants of Demand

1. Price of the commodity itself 2. Income of the consumer 3. Price of related goods 4. Taste and Preference 5. Expectations of future price change
Demand Function: Dx = f(Px, Y, Pr, T)

Law of Demand: Other things remains constant, demand of a good falls with rise in price and vice versa .



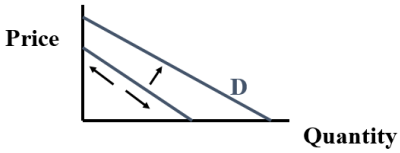
Changes in Demand

They are of two types:
1) Change in Quantity Demanded (Movement along the same demand curve)
2) Change in Demand (Shifts in demand)

1) Change in Quantity Demanded: -
Demand changes due to change in price of the commodity alone, other factors remain constant; are of two types;
A) Expansion of demand: More demand at a lower price
B) Contraction of demand: Less demand at a higher price

Change in Quantity Demanded
Due to price change → Movement will takes place → Extension and contraction

Change in Demand
Due to other than price change → Shifting will takes place → Increase and decrease



Change in demand

Demand changes due to change in factors other than price of the commodity, are of two types:

A) **Increase in demand**:- more demand due to change in other factors, price remaining constant.

B) **Decrease in demand**:- less demand due to change in other factors, price remaining constant.

Causes of Increase in Demand

1. Increase in Income.
2. Increase/ favorable change in taste and preference.
3. Rise in price of substitute good.
4. Fall in price of complementary good.

Note: Increase in income causes increase in demand for normal good

Causes of Decrease in Demand:

1. Decrease in Income.
2. Unfavorable/Decrease in taste and preference
3. Decrease in price of substitute good.
4. Rise in price of complementary good.

Note: Decrease in income causes Decrease in demand for normal good

Type of Goods

- **Substitute Goods**: Increase in the price of one good causes increase in demand for other good. E.g., tea and Coffee
- **Complementary Goods**: Increase in the price of one good causes decrease in demand for other good. E.g:- Petrol and Car
- **Normal Good**: Goods which are having positive relation with income. It means when income rises, demand for normal goods also rises.
- **Inferior Goods**: Goods which are having negative relation with income. It means less demand at higher income and vice versa.
- **Normal goods:** the quantity demanded of such commodities increases as the consumer's income increases and decreases as the consumer's income decreases. Such goods are called normal goods.
- **Giffen goods:** a Giffen good is an inferior good which people consume more of as price rises, violating the law of demand. In the Giffen good situation, cheaper close substitutes are not available. Because of the lack of substitutes, the income effect dominates, leading people to buy more of the good, even as its price rises.
- **Veblen good (aka ostentatious goods):** Often confused with Giffen goods, Veblen goods are goods for which increased prices will increase quantity demanded. However, this is not because the consumers are forced into buying more of the good due to budgetary constraints (as in Giffen goods). Rather, Veblen goods are high-status goods such as expensive wines, automobiles, watches, or perfumes. The utility of such goods is associated with their ability to denote status. Decreasing their price decreases the quantity demanded because their status-denoting utility becomes compromised.

TYPES OF DEMAND

- **Cross demand:** Demand primarily dependent upon prices of related goods is called cross demand. The complementary goods and substitutes are called related goods. In case of complementary goods like pen and ink demand for good is inversely related to the prices of other goods but the case in substituting goods are just opposite. Demand for substituting goods is directly related to prices.
- **Income demand:** Demand primarily dependent upon income is called income demand.
- **Direct demand:** Demand for goods and services made by final consumers to satisfy their wants or needs is called direct demand. For example guest of hotels make the demand for food.
- **Derived demand:** Demand for goods and services made according to direct demand is called derived demand.
- **Joint demand:** Demand made for two or more goods and services to satisfy single need or want is called joint demand.
- **Composite demand:** Demand for a single commodity made in order to use for different purposes is called composite demand.

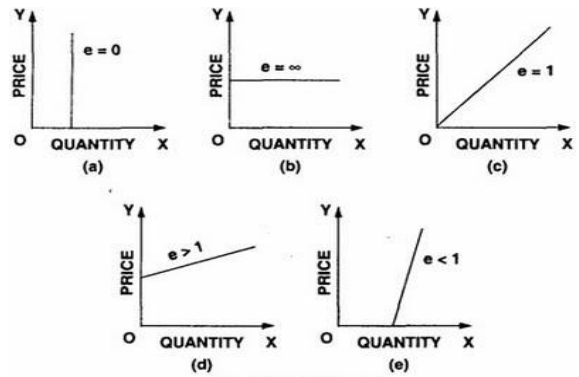
Price Elasticity of Demand (Ed)

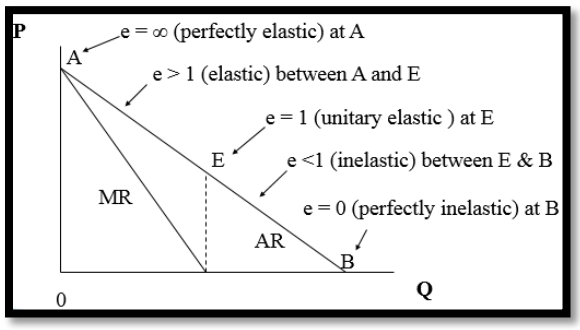
It refers to the degree of responsiveness of quantity demanded to change in its price.

Ed. = Percentage change in quantity demanded/ Percentage change in price

Ed. = P/q X Δq/Δp

P = Original price Q = Original quantity Δ = Change





Perfectly inelastic demand (Ed = 0)
This describes a situation in which demand shows no response to a change in price. In other words, whatever be the price the quantity demanded remains the same.

Inelastic (less elastic) demand (e < 1)
In this case the proportionate change in demand is smaller than in price.

Unitary elasticity demand (e = 1)
When the percentage change in price produces equivalent percentage change in demand, we have a case of unit elasticity. The rectangular hyperbola as shown in the figure demonstrates this type of elasticity.

Elastic (more elastic) demand (e > 1)
In case of certain commodities, the demand is relatively more responsive to the change in price. It means a small change in price induces a significant change in, demand.

Perfectly elastic demand (e = ∞)
This is experienced when the demand is extremely sensitive to the changes in price. In this case an insignificant change in price produces tremendous change in demand. The demand curve showing perfectly elastic demand is a horizontal straight line.

Determinants of Price Elasticity

- Availability of substitutes
- Proportion of income spent
- Time period

Income Elasticity

- Percentage change in demand caused by one percent change in income, *ceteris paribus.*
- E_I = (% Δ in demand) / (% Δ in income)
- $E_I = (\Delta Q / \Delta I).(I / Q)$
- Necessities ($0 < E_I \leq 1$): e.g., basic food items

Engel's Law: % of income spent on food decreases as income increases.

Cross-elasticity of demand

The responsiveness of demand to changes in prices of related goods is called cross-elasticity of demand (related goods may be substitutes or complementary goods). In other words, it is the responsiveness of demand for commodity x to the change in the price of commodity y.
ec = Percentage change in the quantity demanded of commodity X/Percentage change in the price of commodity y

Measures of cross-elasticity of demand

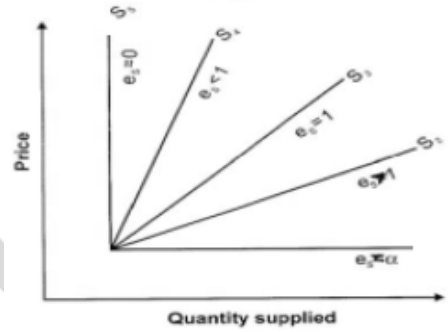
Infinity - Commodity x is nearly a perfect substitute for commodity y
Zero - Commodities x and y are not related.
Negative - Commodities x and y are complementary.

LAW OF SUPPLY

Supply means the goods offered for sale at a price during a specific period of time. It is the capacity and intention of the producers to produce goods and services for sale at a specific price. The supply of a commodity at a given price may be defined as the amount of it which is actually offered for sale per unit of time at that price.
The law of supply establishes a direct relationship between price and supply. Firms will supply less at lower prices and more at higher prices. "Other things remaining the same, as the price of commodity rises, its supply expands and as the price falls, its supply contracts".

Elasticity of Supply

The law of supply tells us that quantity supplied will respond to a change in price. The concept of elasticity of supply explains the rate of change in supply as a result of change in price. It is measured by the formula mentioned below
Elasticity of supply = Proportionate change in quantity supplied/Proportionate change in price



FORMS OF MARKET AND PRICE DETERMINATION

Market: Market is a place in which buyers and sellers come into contact for the purchase and sale of goods and services.
Market structure: refers to number of firms operating in an industry, nature of competition between them and the nature of product.

Types of market
a) Perfect competition. b) Monopoly c) Monopolistic Competition d) Oligopoly.

a) **Perfect competition:** refers to a market situation in which there are large number of buyers and sellers. Firms sell homogeneous products at a uniform price.
b) **Monopoly market:** Monopoly is a market situation dominated by a single seller who has full control over the price.
c) **Monopolistic competition:** It refers to a market situation in which there are many firms who sell closely related but differentiated products.
d) **Oligopoly:** is a market structure in which there are few large sellers of a commodity and large number of buyers.

Features of perfect competition:

1. Very large number of buyers and sellers.
2. Homogeneous product.
3. Free entry and exit of firms.
4. Perfect knowledge.
5. Firm is a price taker and industry is price maker.
6. Perfectly elastic demand curve (AR=MR)
7. Perfect mobility of factors of production.
8. Absence of transportation cost.

9. Absence of selling cost.

Features of monopoly:

1. Single seller of a commodity.
2. Absence of close substitute of the product.
3. Difficulty of entry of a new firm.
4. Negatively sloped demand curve(AR>MR)
5. Full control over price.
6. Price discrimination exists
7. Existence of abnormal profit.

Features of monopolistic competition

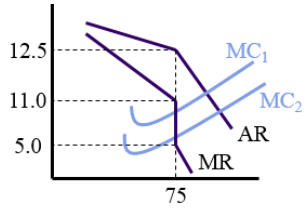
1. Large number of buyers and sellers but less than perfect competition.
2. Product differentiation.
3. Freedom of entry and exit.
4. Selling cost.
5. Lack of perfect knowledge.
6. High transportation cost.
7. Partial control over price.

Main features of Oligopoly.

1. Few dominant firms who are large in size
2. Mutual interdependence.
3. Barrier to entry.
4. Homogeneous or differentiated product.
5. Price rigidity.

The Kinked Demand Model

- Explains rigidity of prices in an oligopoly market.
- Does not explain how the price was determined originally



Features of pure competition

1. Large number of buyers and sellers.
2. Homogeneous products.
3. Free entry and exit of firm.

What are selling cost?
Ans.: Cost incurred by a firm for the promotion of sale is known as selling cost. (Advertisement cost)

What is product differentiation?
Ans: It means close substitutes offered by different producers to show their output differs from other output available in the market. Differentiation can be in colour, size packing, brand name etc to attract buyers.

What do you mean by patent rights?
Ans:- Patent rights is an exclusive right or license granted to a company to produce a particular output under a specific technology.

What is price discrimination?
Ans: - It refers to charging of different prices from different consumers for different units of the same product.

What is Advertising?
Advertising is one way of achieving product differentiation. The objective of advertising is to shift demand curve to right and make demand less elastic

PRODUCTION

Production: Combining inputs in order to get the output is production.

Production Function: It is the functional relationship between inputs and output in a given state of technology. **Q= f(L,K)** Here: Q is the output, L: Labor, K: Capital

Fixed Factor: The factor whose quantity remains fixed with the level of output.

Variable Factor: Those inputs which change with the level of output.

PRODUCTION FUNCTION AND TIME PERIOD

1. Production function is a long period production function if all the inputs are varied.
2. Production function is a short period production function if few variable factors are combined with few fixed factors.

Concepts of product:

Total Product- Total quantity of goods produced by a firm / industry during a given period of time with given number of inputs.
Average product = output per unit of variable input.
APP = TPP / units of variable factor
Average product is also known as average physical product.
Marginal product (MP): refers to addition to the total product, when one more unit of variable factor is employed.
MPn = TPn – TPn-1
MPn = Marginal product of nth unit of variable factor
TPn = Total product of n units of variable factor
TPn-1= Total product of (n-1) unit of variable factor.
n=no. of units of variable factor
MP = ΔTP / Δn
We derive TP by summing up MP TP = ΣMP

Short Run Production Function Law Of Variable Proportion Or Returns To A Variable Factor

Statement of law of variable proportion: In short period, when only one variable factor is increased, keeping other factors constant, the total product (TP) initially increases at an increasing rate, then increases at a decreasing rate and finally TP decreases.
MPP initially increase then falls but remains positive then 3rd phase becomes negative.

Phase I / Stage I / Increasing returns to a factor.

- TPP increases at an increasing rate
- MPP also increases.

Phase II / Stage II / Diminishing returns to a factor

- TPP increases at decreasing rate
- MPP decreases / falls
- This phase ends when MPP is zero & TPP is maximum

Phase III / Stage III / Negative returns to a factor

- TPP diminishes / decreases
- MPP becomes negative.

Reasons for increasing returns to a factor

- Better utilization of fixed factor
- Increase in efficiency of variable factor.
- Optimum combination of factors

Reasons for diminishing returns to a factor

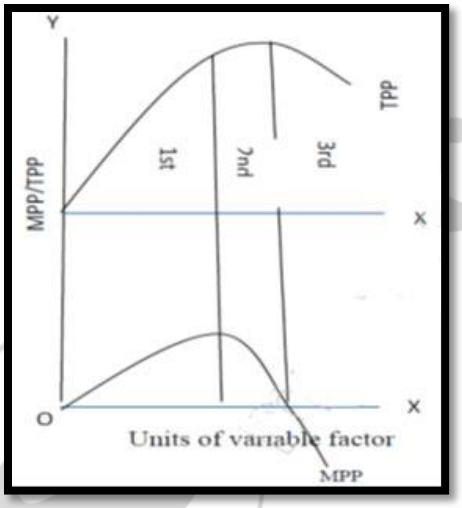
- Indivisibility of factors.
- Imperfect substitutes.

Reasons for negative returns to a factor

- Limitation of fixed factors
- Poor coordination between variable and fixed factor
- Decrease in efficiency of variable factors.

Relation between MPP and TPP

- As long as MPP increases, TPP increases at an increasing rate.
- When MPP decreases, TPP increases diminishing rate.
- When MPP is Zero, TPP is maximum.
- When MPP is negative, TPP starts decreasing.



Long-run production function - Returns to Scale

In the long run, all factors can be changed. Returns to scale studies the changes in output when all factors or inputs are changed. An increase in scale means that all inputs or factors are increased in the same proportion.

Three phases of returns to scale

The changes in output as a result of changes in the scale can be studied in 3 phases. They are
(i) Increasing returns to scale(ii) Constant returns to scale (iii) Decreasing returns to scale

Increasing returns to scale

If the increase in all factors leads to a more than proportionate increase in output, it is called increasing returns to scale. For example,
if all the inputs are increased by 5%, the output increases by more than 5% i.e. by 10%. In this case the marginal product will be rising.

Constant returns to scale

If we increase all the factors (i.e. scale) in a given proportion, the output will increase in the same proportion i.e. a 5% increase in all the factors will result in an equal proportion of 5% increase in the output. Here the marginal product is constant.

Decreasing returns to scale

If the increase in all factors leads to a less than proportionate increase in output, it is called decreasing returns to scale i.e. if all the factors are increased by 5%, the output will increase by less than 5% i.e. by 3%. In this phase marginal product will be decreasing.

The Cobb – Douglas Production Function

- The simplest and the most widely used production function in economics is the Cobb-Douglas production function. It is a statistical production function given by professors C.W. Cobb and P.H. Douglas.
- The Cobb-Douglas production function can be stated as follows: $\mathbf{Q = bL^aC^{1-a}}$

in which **Q =** Actual output **L =** Labour **C =** Capital **b =** number of units of Labour **a =** Exponent of labour **1-a =** Exponent of Capital

- According to the above production function, if both factors of production (labour and capital) are increased by one percent, the output (total product) will increase by the sum of the exponents of labour and capital i.e. by (a+1-a). Since a+1-a =1, according to the equation, when the inputs are increased by one percent, the output also increases by one percent. Thus, the Cobb Douglas production function explains only constant returns to scale.
- In the above production function, the sum of the exponents shows the degree of "returns to scale" in production function.

a + b >1 : Increasing returns to scale
a + b =1 : Constant returns to scale
a + b <1 : Decreasing returns to scale

COST

Cost of production: Expenditure incurred on various inputs to produce goods and services.

Cost function: Functional relationship between cost and output. C=f(q) Where f=functional relationship **where** c= cost of production q=quantity of product

Types of Cost

- **Money cost**: Money expenses incurred by a firm for producing a commodity or service.

- **Explicit cost**: Actual payment made on hired factors of production. For example wages paid to the hired labourers, rent paid for hired accommodation, cost of raw material etc.
- **Implicit cost**: Cost incurred on the self - owned factors of production. For example, interest on owners capital, rent of own building, salary for the services of entrepreneur etc.
- **Opportunity cost**: is the cost of next best alternative foregone / sacrificed.
- **Fixed cost**: are the cost which are incurred on the fixed factors of production. These costs remain fixed whatever may be the scale of output. These costs are present even when the output is zero. These costs are present in short run but disappear in the long run.
- **Total Variable Cost**: TVC or variable cost – are those costs which vary directly with the variation in the output. These costs are incurred on the variable factors of production. These costs are also called "prime costs", "Direct cost" or "avoidable cost". These costs are zero when output is zero.
- **Total Cost**: is the total expenditure incurred on the factors and non-factor inputs in the production of goods and services. It is obtained by summing TFC and TVC at various levels of output.

Relation between TC, TFC and TVC

1. TFC is horizontal to x axis.
2. TC and TVC are S shaped (they rise initially at a decreasing rate, then at a constant rate & finally at an increasing rate) due to law of variable proportions.
3. At zero level of output TC is equal to TFC.
4. TC and TVC curves parallel to each other.

Average variable cost

- **It** is the cost per unit of the variable cost of production.
- AVC = TVC / output.
- AVC falls with every increase in output initially.
- Once the optimum level of output is reached AVC starts rising.

Average total cost (ATC) or Average cost (AC): refers to the per unit total cost of production.
Marginal cost: Refers to the addition made to total cost when an additional unit of output is produced.
MCn = TCn-TCn-1 or MC = ΔTC / ΔQ
Note : MC is not affected by TFC.

Relationship between AC and MC

- Both AC & MC are derived from TC
- Both AC & MC are "U" shaped (Law of variable proportion)
- When AC is falling MC also falls & lies below AC curve.
- When AC is rising MC also rises & lies above AC
- MC cuts AC at its minimum where MC = AC

Revenue

Revenue: Money received by a firm from the sale of a given output in the market.
Total Revenue: Total sale receipts or receipts from the sale of given output.
TR = Quantity sold × Price (or) output sold × price
Average Revenue: Revenue or Receipt received per unit of output sold.

- AR = TR / Output sold
- AR and price are the same.
- TR = Quantity sold × price or output sold × price
- AR = (output / quantity × price) / Output/ quantity
- AR= price
- AR and demand curve are the same. Shows the various quantities demanded at various prices.

Marginal Revenue: Additional revenue earned by the seller by selling an additional unit of output. MRn = TR n - TR n-1 · TR = Σ MR

Relationship between AR and MR (when price remains constant or perfect competition)
Under perfect competition, the sellers are price takers. Single price prevails in the market. Since all the goods are homogeneous and are sold at the same price AR = MR. As a result AR and MR curve will be horizontal straight line parallel to OX axis. (When price is constant or perfect competition)

Relation between TR and MR (When price remains constant or in perfect competition)
When there exists single price, the seller can sell any quantity at that price, the total revenue increases at a constant rate (MR is horizontal to X axis)

Relationships between AR and MR under monopoly and monopolistic competition (Price changes or under imperfect competition)

- AR and MR curves will be downward sloping in both the market forms.
- AR lies above MR.
- AR can never be negative.
- AR curve is less elastic in monopoly market form because of no substitutes.
- AR curve is more elastic in monopolistic market because of the presence of substitutes.

Relationship between TR and MR. (When price falls with the increase in sale of output)

- Under imperfect market AR will be downward sloping – which shows that more units can be sold only at a less price.
- MR falls with every fall in AR / price and lies below AR curve.
- TR increases as long as MR is positive.
- TR falls when MR is negative.
- TR will be maximum when MR is zero

Break-even point: It is that point where TR = TC or AR=AC. Firm will be earning normal profit.
Shut down point: A situation when a firm is able to cover only variable costs or TR = TVC
Formulae at a glance:

- TR = price or AR × Output sold or TR = Σ MR
- AR (price) = TR ÷ units sold
- MR n = MR n – MR n-1

MACRO ECONOMICS

Important concepts of National Income

1. Gross Domestic Product at Market Price.2. Gross National Product at Market Price.
3. Net Domestic Product at Market Price.4. Net National Product at Market Price.
5. Net Domestic Product at Factor Cost.6. Net National Product at Factor Cost.
7. Gross Domestic Product at Factor Cost.8. Gross National Product at Factor Cost.
9. Private Income.10. Personal Income11. Disposable Income.

(1) Gross Domestic Product at Market Price (GDP at MP):-

Gross domestic product at market price is the aggregate money value of the final goods and services produced within the country's own territory. So as to calculate GDP at MP all goods and services produced in the domestic territory are multiplied by their respective prices. Symbolically GDP at MP = PXQ. Where P is market price and Q is final goods and services.

(2) Gross National Product of Market Price (GNP at MP):-

Gross national product at market price is broad and comprehensive concept. GNP at MP measures the money value of all the final products produced annually in a counter plus net factor income from abroad. In short GNP is GDP plus net factor incomes earned from abroad. Net factor incomes is derived by reducing the factor incomes earned by foreigners from the country, in question from the factor incomes earned by the residents of that country from abroad.

(3) Net Domestic Product at Market Price (NDP at MP):-

Net domestic product- at market price is the difference between Net National Product at market price and net factor income from abroad. Net domestic product at market price is the difference been GNP at market price minus depreciation and net factor incomes from abroad.

(4) Net National Product at Market Price (NNP at MP):-

Net National product measures the net money value of final goods and services at current prices produced in a year in a country. It is the gross national product at market price less depreciation. In production of output capital assets are constantly used up. This fixed capital consumption is called depreciation. Depreciation constitutes loss of value of fixed capital. Thus net national product is the net money value of final goods and services produced in the course of a year. Net money value can be arrived at by excluding depreciation allowance from total output.

(5) Net Domestic Product at Factor Cost (NDP at FC):-

Net Domestic product of factor cost or domestic income is the income earned by all the factors of production within the domestic territory of a country during a year in the form of wages, interest, profit and rent etc. Thus NDP at FC is a territorial concept. In other words NDP at factor cost is equal to NNP at FC less net factor income from abroad.

(6) Net National Product at Factor Cost (NNP at FC)

Net national product at factor cost is the aggregate payments made to the factors of production. NNP at FC is the total incomes earned by all the factors of production in the form of wages, profits, rent, interest etc. plus net factor income from abroad. NNP at FC is the NDP at FC plus net factor income from abroad. NNP at FC can also be derived by excluding depreciation from GNP at FC.

(7) Gross Domestic Product at Factor Cost (GDP at FC):

Gross Domestic Product at factor cost refers to the value of all the final goods and services produced within the domestic territory of a country. If depreciation or consumption of fixed capital is added to the net domestic product at factor cost, it is called Gross domestic Product at Factor cost.

(8) Gross National Product at Factor Cost (GNP at FC):-

Gross national product at factor cost is obtained by deducting the indirect tax and adding subsidies to GNP at market price or Gross national Product at factor cost is obtained by adding net factor incomes from abroad to the GDP at factor cost.

(9) Private Income:-

Private income means the income earned by private individuals from any source whether productive or unproductive. It can be arrived at from NNP at factor cost by making certain additions and deduction. The additions include (a) transfer earnings from Govt, (b) interest on national debt (c) current transfers from rest of the world. The deductions include (a) Income from property and entrepreneurship (b) savings of the non-departmental undertakings (e) social security contributions. In order to arrive at private income the above additions and subtraction are to be made to and from NNP at factor Cost.

(10) Personal Income:-

Personal Income is the total income received by the individuals of country from all sources before direct taxes. Personal income is not the same as National Income, because personal income includes the transfer payments where as they are not included in national income. Personal income includes the wages, salaries, interest and rent received by the individuals. Personal income is derived by excluding undistributed corporate profit taxes etc. from National Income.

(11) Disposable Income:-

Disposable income means the actual income which can be spent on consumption by individuals and families. It refers to the purchasing power of the house hold. The whole of disposable income is not spent on consumptions; a part of it is paid in the form of direct tax. Thus disposable income is that part of income, which is left after the exclusion of direct tax.

Concepts

- NNP Mp = GNP mp - depreciation
- NDP Mp = GDPmp – depreciation
- NDP Fc = NDP mp – Net indirect taxes (indirect tax – subsidies)
- GDP Fc = NDP fc + depreciation
- NNP Fc = GDP mp - depreciation + Net factor income from abroad – Net indirect taxes

Define nominal GNP

Ans. GNP measured in terms of current market prices is called nominal GNP.

Define Real GNP.

Ans. GNP computed at constant prices (base year price) is called real GNP.

Factor Payment: Factor payment is a payment made in lieu of providing goods and services. A worker gets the wages is the factor payment because he worked for it.

Transfer payment: If there is no obligation involved to deliver service or goods in return of the payments is called transfer payment. Examples are: donation, old age pension, unemployment benefit, scholarship etc.

METHODS OF CALCULATING NATIONAL INCOME

I - PRODUCT METHOD (Value added method):

- Sales + change in stock = value of output
- Change in stock = closing stock – opening stock
- Value of output - Intermediate consumption = Gross value added (GDPMp)
- NNP Fc (N.I) = GDPMp (-) consumption of fixed capital (depreciation)

(+) Net factor income from abroad (-) Net indirect tax.

Income method:

1. Compensation of employees.

2. Operating surplus.
Income from property- Rent & Royalty Interest
Income from Entrepreneurship- Profit, Corporate dividend, Tax Savings (Net retained earnings)

3. Mixed income of self-employed.

- NDP fc = (1) + (2) + (3)
- NNP fc = NDP fc (+) Net factor income from abroad
- GNP mp = NDP fc + consumption of fixed capital + Net indirect tax(Indirect tax – subsidy)

Expenditure method:
1. Government final consumption expenditure.
2. Private final consumption expenditure.
3. Net Export.
4. Gross domestic capital formation=**Gross Domestic fixed Capital formation+ Change in stock**

GDPmp = (1) + (2) + (3) + (4)
NNP fc = GDPmp - consumption of fixed capital + NFIA- Net indirect taxes
Note: If capital formation is given as Net domestic capital formation we arrive at NDPmp.Capital formation = Investment

INTRODUCTION TO MACRO

Autonomous consumption: The consumption which does not depend upon income or the amount of consumption expenditure when income is zero.

Autonomous Investments: It is Investment which is made irrespective of level of income. It is generally run by the government sector. It is income inelastic. Thevolume of autonomous investment is same at all level of income.

Investment multipliers and its working.
Investment multiplier explains the relationship between increase in investment and the resultant increase in income.
Investment multiplier is the ratio of change in income to change in investment. Multiplier (k) =Δy/ΔI.
The value of multiplier depends on the value of marginal propensity to consume (MPC).
There is direct relationship between k and MPC.

INFLATION TYPES

Comprehensive Inflation: When the prices of allcommodities rise throughout the economy.

Sporadic Inflation: When prices of only few commodities in few regions (areas) rise. It is sectional in nature.

Open Inflation: When government does not attempt torestrict inflation, it is known as Open Inflation. In a free market economy, where prices are allowed to take its own course, open inflation occurs.

Suppressed Inflation: When government prevents price rise through price controls, rationing, etc., it is known as Suppressed Inflation. It is also referred as Repressed Inflation.

Hyperinflation: Hyperinflation refers to a situationwhere the prices rise at an alarming high rate. Theprices rise so fast that it becomes very difficult to measure its magnitude. However, in quantitative terms, when prices rise above 1000% per annum (quadruple or four digit inflation rate), it is termed as Hyperinflation.
Deficit Inflation: Deficit inflation takes place due to deficit financing.
Credit Inflation: Credit inflation takes place due toexcessive bank credit or money supply in the economy.
Scarcity Inflation: Scarcity inflation occurs due tohoarding. Hoarding is an excess accumulation of basic commodities by unscrupulous traders and black marketers.
Profit Inflation: When entrepreneurs are interested inboosting their profit margins, prices rise.
Demand-Pull Inflation: Inflation which arises due to various factors like rising income, exploding population, etc., leads to aggregate demand and exceeds aggregate supply, and tends to raise prices of goods and services. This is known as Demand-Pull or Excess Demand Inflation.

Cost-Push Inflation: When prices rise due to growingcost of production of goods and services, it is knownas Cost-Push (Supply-side) Inflation. For e.g. If wages of workers are raised then the unit cost of production alsoincreases. As a result, the prices of end-products orend-services being produced and supplied areconsequently hiked.

Money supply
The Reserve Bank of India (RBI) is the central bank of our country. It manages the monetary system of our country. It has classified the money supply of our country into four components.
They are :
M1 = Currency with the public. It includes coins and currency notes + demand deposits of the public. M1 is also known as narrow money ;
M2 = M1 + post office savings deposits ;

M3 = M1 + Time deposits of the public with the banks. M3 is also known as broad money ; and
M4 = M3 + total post office deposits.
Note: Besides savings deposits, people maintain fixed deposits of different maturity periods with the post office.

Fiat Money: Currency notes in circulation are normally referred to as fiat money. For example, one Rupee notes issued by the Government of India is Fiat money.The notes issued by the RBI are usually referred to as bank notes.They are in the nature of promissory notes.

TAX STRUCTURE IN INDIA
Taxes are the amount of money government imposes on an individual or corporates directly or indirectly so as to generate revenue or to keep in check any black money activities in India.
The tax on incomes, customs duties, central excise and service tax are levied by the Central Government. The state Government levies agricultural income tax (income from plantations only), Value Added Tax (VAT)/ Sales Tax, Stamp Duty, State Excise, Land Revenue, Luxury Tax and Tax On Professions. The local bodies have the authority to levy tax on properties, octroi/entry tax and tax for utilities like water supply, drainage etc.

DIRECT TAXES-
These taxes are levied directly on the persons.These contributes major chunk of the total taxes collected in India.

INCOME TAX- This is a type of tax levied on the individuals whose income falls under the taxable category (2.5 lakhs per annum).
The Indian Income Tax Department is governed by CBDT and is part of the Department of Revenue under the Ministry of Finance, Govt. of India.

Corporate Income Tax - This is the tax levied on the profits a corporate house earned in a year. In India, the Corporate Income tax rate is a tax collected from companies.

Securities Transaction Tax
Introduced in 2004, STT is levied on the sale and purchase of equities (ie Shares, Debentures or any other security). more clearly, The income a individual generate through the securities market be it through reselling of shares or through debentures is taxed by the government of India and the same tax is called as Securities Transaction Tax.

Banking Cash Transaction Tax
A bank transaction tax is a tax levied on debit (and/or credit) entries on bank accounts. It can be automatically collected by a central counterparty in the clearing or settlement process.

Capital Gains Tax:
Capital Gain tax as name suggests it is tax on gain in capital. If you sale property, shares, bonds & precious material etc. and earn profit on it then you are supposed to pay capital gain tax.

- **PROPERTY TAX**
- **GIFT TAX**
- **HOUSE TAX**
- **PROFESSIONAL TAX**
- **DTC**

INDIRECT TAXES
You go to a super market to buy goods or to a restaurant to have a mouthful there at the time of billing you often see yourself robbed by some more amount than what you enjoyed of, these extra amounts are indirect taxes, which are collected by the intermediaries and when govt tax the income of the intermediaries this extra amount goes in to government's kitty, hence as the name suggests these are levied indirectly on common people.
Indirect Taxes:-

- SALES TAX
- VAT(VALUE ADDED TAX)
- CUSTOM DUTY
- OCTROI
- EXCISE DUTY
- ANTI DUMPING DUTY
- ENTERTAINMENT TAX
- TOLL TAX
- SERVICE TAX
- GST-GOODS & SERVICE TAX

Value Added Tax
When we pay an extra amount of price for the goods and services we consume or buy, that extra amount of money is called as VAT. This taxes is about to be replaced by Goods and Services Tax.

Customs Duty
Customs Duty is a type of indirect tax levied on goods imported into India as well as on goods exported from India. In India, the basic law for levy and collection of customs duty is Customs Act, 1962. It provides for levy and collection of duty on imports and exports.

Service Tax-
Service Tax is a tax imposed by Government of India on services provided in India. The service provider collects the tax and pays the same to the government. It is charged on all services except the services in the negative list of services.

Sales Tax :-
Sales tax charged on the sales of movable goods.

Custom duty & Octroi (On Goods):-
Custom Duty is a type of indirect tax charged on goods imported into India. One has to pay this duty, on goods that are imported from a foreign country into India
Octroi is tax applicable on goods entering from one state to another for consumption or sale. In simple terms one can call it as Entry Tax.

Excise Duty:-
An excise duty is a type of tax charged on goods produced within the country. Another name of this tax is CENVAT (Central Value Added Tax).

GOVERNMENT BUDGET AND THE ECONOMY

1. Define a Budget.
Ans: It is an annual statement of the estimated Receipts and Expenditures of the Government
over the fiscal year which runs from April –I to March 31.

2. Name the two broad divisions of the Budget.
Ans: i) Revenue Budget ii) Capital Budget

3. What are the two Budget Receipts?
Ans: i) Revenue Receipts ii) Capital Receipts

4. Name the two types of Revenue Receipts.
Ans: i) Tax Revenue ii) Non-tax Revenue

5. What are the two types of taxes?
Ans: a) Direct Taxes: i) Income Tax, ii) Interest Tax, iii) Wealth Tax
b) Indirect Taxes: i) Customs duties, ii) Excise duties, iii) Sales Tax

6. What are the main items of Capital Receipts?
Ans: a) Market Loans (loans raised by the government from the public)
b) Borrowings by the Government
c) Loans received from foreign governments and International financial Institutions.

7. Give two examples of Developmental Expenditure.
Ans: Plan expenditure of Railways and Posts

8. Give two examples of Non-Developmental expenditures.
Ans: i) Expenditure on defence
ii) Interest payments

9. Define Surplus Budget.
Ans: A Surplus Budget is one where the estimated revenues are greater than the Estimated expenditures.

10. What are the four different concepts of Budget Deficits?
Ans: a) Budget Deficit b) Revenue Deficit
c) Primary Deficit andd) Fiscal Deficit

BUDGET
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What do you mean by Revenue Expenditure and Capital Expenditure?
i) Revenue Expenditure :- It is the expenditure incurred for the normal running of government departments and provision of various services like interest charges on debt, subsidies etc.,

ii) Capital Expenditure:- It consists mainly of expenditure on acquisition of assets like land, building, machinery, equipment etc., and loans and advances granted by the Central Government to States & Union Territories.

Explain the four different concepts of Budget deficit.
These are the four different concepts of Budget Deficit.
a) Budget Deficit:- It is the difference between the total expenditure, current revenue and net internal and external capital receipts of the government.

Formulae: B.D = B.E > B.R (B.D= Budget Deficit, B.E. Budget Expenditure B.R= Budget Revenue
b) Fiscal Deficit:- It is the difference between the total expenditure of the government, the revenue receipts PLUS those capital receipts which finally accrue to the government.

Formulae: F.D = B.E - B.R (B.E > B.R. other than borrowings) F.D=Fiscal Deficit, B.E= Budget Expenditure, B.R. = Budget Receipts.
c) Revenue Deficit: - It is the excess of governments revenue expenditures over revenue receipts.
Formulae: R.D= R.E – R.R., When R.E > R.R., R.D= Revenue Deficit, R.E= Revenue Expenditure, R.R. = Revenue Receipts.
d) Primary Deficit: - It is the fiscal deficit **MINUS** Interest payments. Formulae: P.D= F.D – I.P, P.D= Primary Deficit, F.D= Fiscal Deficit, I.P= Interest Payment.

BALANCE OF PAYMENTS: MEANING AND COMPONENTS

Meaning: The balance of payments of a country is a systematic record of all economic transactions between residents of a country and residents of foreign countries during a given period of time.

BALANCE OF TRADE AND BALANCE OF PAYMENTS
Balance of trade: Balance of trade is the difference between the money value of exports and imports of material goods (visible item)

Balance of payments: Balance of payments is a systematic record of all economic transactions between residents of a country and the residents of foreign countries during a given period of time. It includes both visible and invisible items. Hence the balance of payments represents a better picture of a country's economic transactions with the rest of the world than the balance of trade.

STRUCTURE OF BALANCE OF PAYMENT ACCOUNTING

A balance of payments statement is a summary of a Nation's total economic transaction undertaken on international account. There are two types of account.

1. **Current Account:** It records the following 03 items.

a) Visible items of trade: The balance of exports and imports of goods is called the balance of visible trade.

b) Invisible trade: The balance of exports and imports of services is called the balance ofinvisible trade E.g. Shipping insurance etc.

c) Unilateral transfers: Unilateral transfers are receipts which resident of a country receive (or) payments that the residents of a country make without getting anything in return e.g. gifts.

The net value of balances of visible trade and of invisible trade and of unilateral transfers isthe balance on current account.

2. **CAPITAL ACCOUNT:** It records all international transactions that involve a resident of the domestic country changing his assets with a foreign resident or his liabilities to a foreign resident.

EXCHANGE

1. Define foreign exchange rate.

Ans: Foreign exchange rate is the rate at which currency of one country can be exchanged for currency of another country.

2. What do you mean by Foreign Exchange Market?

Ans: The foreign exchange market is the market where international currencies are traded for one another.

3. What is meant by Fixed Exchange Rate?

Ans: Fixed Rate of exchange is a rate that is fixed and determined by the government of a country and only the government can change it.

4. What is equilibrium rate of exchange?

Ans: Equilibrium exchange rate occurs when supply of and demand for foreign exchange are equal to each other.

5. Define flexible exchange rate.

Ans: Flexible rate of exchange is that rate which is determined by the demand and supply of different currencies in the foreign exchange market.

6. What is meant by appreciation of currencies?

Ans: Appreciation of a currency occurs when its exchange value in relation to currencies of other country increases.

7. Define Spot exchange rate.

Ans: The spot exchange rate refers to the rate at which foreign currencies are available on the sport.

8. Define forward market.

Ans: Market for foreign exchange for future delivery is known as the forward market.

9. What is meant by balance of payments?

Ans: Balance of payments refers to the statement of accounts recording all economic transactions of a given country with the rest of the world.

INDIAN POLITY CAPSULE

Framing of the Constitution:

a) The Constitution of India was framed by a Constituent Assembly which was set up under the Cabinet mission plan (1946).

b) The Constituent Assembly took almost 3 years (2 years, 11 months, & 18 days) to complete its historic task of drafting the Constitution for an Independent India.

c) During this period it held 11 sessions covering a total of 165 days. Of these, 114 days were spent on the consideration of & discussion on the Draft Constitution.

d) As for the composition of the Assembly, members were chosen by indirect election by the members of the Provincial Legislative Assemblies, following the scheme recommended by the Cabinet Mission. The total membership of the assembly thus was to be 389.

e) However, as a result of the partition, a separate Constituent Assembly was set up for Pakistan & representatives of some provinces ceased to be members of the Assembly. As a result, the membership of the Assembly was reduced to 299.

The Cabinet Mission

World War II in Europe came to an end on May 9,1945. Three British cabinet ministers were sent to find a solution to the question of India's independence. This team of ministers (Lord Pethick Lawrence, Stafford Cripps, A V Alexander) was called the Cabinet Mission. The Mission was in India from March 1946 to May 1946.The Cabinet Mission discussed the framework of the constitution & laid down in some detail the procedure to be followed by the constitution drafting body. The Assembly began work on 9 December 1946.

First Interim National Govt.

The Govt. was constituted on 2 September, 1946. It was leaded by Pundit Nehru. All the members of the interim Govt. were members of Viceroy's Executive Council. The Viceroy continued to be the head of the Council. Pundit Jawahar Lal Nehru was designated as the Vice-President of the Council.

The Constituent Assembly

a) The people of India elected members of the provincial assemblies, who in turn elected the constituent assembly.

b) Frank Anthony represented the Anglo-Indian community.

c) Dr. Sachidanand Sinha was the first president of the Constituent Assembly. Later, Dr.Rajendra Prasad was elected president of the Constituent Assembly while B.R. Ambedkar was appointed the Chairman of the Drafting Committee.

Sources of our Constitution

The Indian Constitution is borrowed from almost all the major countries of the world but has its own unique features too. Major sources are:

1. **Government of India Act of 1935** - Federal Scheme, Office of Governor, Judiciary, Public Service Commission, Emergency provisions & administrative details.
2. **British Constitution** – Parliamentary System, Rule of law, Lagislative Procedure, Single Citizenship, Cabinet System, Prerogative Writs, Parliamentary Privileges & Bicameralism.
3. **US Constitution** – Fundamental rights, independence of judiciary, judicial review, impeachment of president, removal of Supreme court & high court judges & post of vice president.
4. **Irish Constitution-** Directive Principles of State Policy, nomination of members of Rajya Sabha & method of election of president
5. **Canadian Constitution-** Federation with a strong centre, vesting of residuary power in the centre, appointment of state Governor by the centre & advisory jurisdiction of Supreme Court.
6. **Australian Constitution-** Concurrent list, joint sitting of two houses of Parliament.
7. **Constitution of Germany-** Suspension of fundamental rights during emergency.
8. **French Constitution-** Republic & ideals of liberty, equality & fraternity in the Preamble.
9. **South African Constitution-** Procedure for amendment of the constitution & election of members of Rajya Sabha.
10. **Japanese Constitution-** Procedure established by Law.
11. **Constitution of former USSR:** Procedure of five-year plan, fundamental duties, ideals of justice in Preamble.

PARTS DESCRIBED IN THE CONSTITUTION

Part	Subject	Articles
Part I	The Union and its territory	Art. 1 to 4
Part II	Citizenship	Art. 5 to 11
Part III	Fundamental Rights	Art. 12 to 35
Part IV	Directive Principles	Art. 36 to 51
Part IVA	Fundamental Duties	Art. 51A
Part V	The Union	Art. 52 to 151
Part VI	The States	Art. 152 to 237
Part VII	Repealed by Const. (7th Amendment) Act, 1956	
Part VIII	The Union Territories	Art. 239 to 242
Part IX	The Panchayats	Art. 243 to 243O
Part IXA	The Muncipalities	Art. 243P to 243ZG
Part IXB	The Co-operative Societies	Art. 243ZH to 243ZT
Part X	The Scheduled and Tribal Areas	Art. 244 to 244A
Part XI	Relations between the Union and the States	Art. 245 to 263
Part XII	Finance, Property, Contracts and Suits	Art. 264 to 300A
Part XIII	Trade, Commerce and Intercourse within the Territory of India	Art. 301 to 307
Part XIV	Services under the Union and the States	Art. 308 to 323
Part XIVA	Tribunals	Art. 323A to 323B
Part XV	Elections	Art. 324 to 329A

Part XVI	Special provisions relating to certain classes	Art. 330 to 342
Part XVII	Official Language	Art. 343 to 351
Part XVIII	Emergency Provisions	Art. 352 to 360
Part XIX	Miscellaneous	Art. 361 to 367
Part XX	Amendment of the Constitution	Art. 368
Part XXI	Temporary, Transitional and Special Provisions	Art. 369 to 392
Part XXII	Short title, commencement, authoritative text in Hindi and repeals	Art. 393 to 395

IMPORTANT SCHEDULES IN THE CONSTITUTION

Schedules 1 to 12
First schedule contains the list of states and union territories and their territories
Second schedule contains provisions as to the President, Governors of States, Speaker and the Deputy Speaker of the House of the People and the Chairman and the Deputy Chairman of the Council of States and the Speaker and the Deputy Speaker of the Legislative Assembly and the Chairman and the Deputy Chairman of the Legislative Council of a State, the Judges of the Supreme Court and of the High Courts and the Comptroller and Auditor-General of Indiathe list of states and union territories and their territories
Third Schedule contains the Forms of Oaths or Affirmations.
Fourth Schedule contains provisions as to the allocation of seats in the Council of States.
Fifth Schedule contains provisions as to the Administration and Control of Scheduled Areas and Scheduled Tribes.
Sixth Schedule contains provisions as to the Administration of Tribal Areas in the States of Assam, Meghalaya, Tripura and Mizoram.
Seventh Schedule contains the Union list, State list and the concurrent list.
Eighth Schedule contains the list of recognised languages.
Ninth Schedule contains provisions as to validation of certain Acts and Regulations.
Tenth Schedule contains provisions as to disqualification on ground of defection.
Eleventh Schedule (73rd amendment) contains the powers, authority and responsibilities of Panchayats.
Twelfth Schedule (74th amendment) contains the powers, authority and responsibilities of Municipalities.

Fundamental Rights

- They are **justiciable**, allowing persons to move the courts for their enforcement, if & when they are violated.
- They are defended & guaranteed by the Supreme Court. Hence, the aggrieved person can directly go to the Supreme Court. They can be suspended during the operation of a National Emergency except the rights guaranteed by **Articles 20 & 21**. More, the six rights guaranteed by Article 19 can be suspended only when emergency is declared on the grounds of war or external aggression.

Originally the Constitution provided for seven fundamental rights:

1. Right to equality [Art. 14-18]
2. Right to freedom [Art. 19-22]
3. Right against exploitation [Art. 23-24].
4. Right to freedom [Art. 25-28]
5. Cultural & educational rights [Art. 29-30]
6. Right to property [Art. 31]
7. Right to constitutional remedies [Art. 32]

However, the 'right to property' was deleted from the list of fundamental rights by the **44th Constitutional Amendment Act, 1978**. It has been made a legal right under **Article 300- A** in the Constitution. So, at present, there are only six fundamental rights.

Part-IV: Directive Principles of State Policy [Article 36 to 51]

The phrase 'Directive Principles of State Policy' denotes the ideals that the State should keep in mind while formulating policies & enacting laws. It includes the legislative & executive organs of the central & state governments, all local authorities & all other public authorities in the country. The Directive Principles are **non-justiciable in nature,** that is, they are not legally enforceable by the courts for their violation. Therefore, the government cannot be compelled to implement them. They aim at providing social & economic justice of the people.

FUNDAMENTAL DUTIES

A list of ten fundamental duties was included in the Indian **Constitution by the 42nd Amendment Act, 1976 in the form of Article 51 A.** For this a new part was created in the Constitution in the form of Part IV-A. **It is based on the Japanese model.** The idea of including a separate chapter on duties was recommended by the ***Swam Singh Committee*** in view of the fact that duties & rights are inseparable. Moreover, subsequently **11th duty has been added by Constitution (86th Amendment) Act, 2002 in the form of 51 A (k).** It reads:
"It shall be the duty of every citizen of India "who is a parent or guardian to provide opportunities for education to his child or, as the case may be, ward between the age of six & fourteen years."

CITIZENSHIP

A citizen is a person who enjoys full membership of the community or State in which he lives or ordinarily lives. The State demands extra duty from its citizen which cannot be asked to non-citizens. 42nd Constitution (Amendment) Act, 1976 has inserted 10 Fundamental Duties in Article 51-A.

Ways to acquire Indian Citizenship

Constitution of India under Citizenship (Amendment) Act, 1986 provides five ways to acquire citizenship of India. These five ways are:

a) Citizenship by Birth
b) Citizenship by Descent

c) Citizenship by Registration
d) Citizenship by Naturalization
e) Citizenship by incorporation of Territory

THE UNION EXECUTIVE

The President

Article 52 – There shall be a President of India.
Article 53 – The executive power of the Union shall be vested in the President.
Thus the President is:
(1) Executive head of the Republic.
(2) All the executive actions are taken in his name. The executive power vested in the President is to be exercised on the aid & advice of the Council of Ministers [Article 74(1)]. It is obligatory on the part of President to accept the advice of the council of ministers as per the 42ndand 44th Constitutional Amendment Acts.
(3) He is the first citizen of India & occupies the first position under the warrant of precedence. Warrant of Precedence indicates the hierarchy of positions occupied by various dignitaries attending a state function.
(4) He is the Supreme Commander of Armed Forces.

Election of the President

The President of India is elected by indirect election. He is elected by an electoral college in accordance with the system of proportional representation by means of the single transferable vote & the vote being secret.

Article 54 –
The Electoral College consists of:
(a) The elected members of both houses of Parliament (nominated members are not the members of electoral college)
(b) The elected members of the Legislative Assemblies of the States (including National Capital Territory of Delhi & the Union Territory of Pondicherry)

Manner of Election of the President

The provisions dealing with the manner of election of the President of India are provided in Article 55. He is elected following the system of proportional representation by means of single transferable vote.
Article 62 of the Constitution provides that an election to fill a vacancy shall be held as soon as possible after, & in no case later than six months from, the date of occurrence of the vacancy (if such occurrence of vacancy is caused by resignation or death or impeachment or otherwise).

Qualification for election as President

(a) He must be a citizen of India.
(b) He must have completed the age of 35 years.
(c) He must be qualified for election as a Member of the House of the People.
(d) He must not hold any office of Profit under the Govt. of India or the Govt. of any State or under any local or other authority subject to the control of any of the said Govt. However, following persons are not deemed to be holding any office of profit & hence they cannot be disqualified for election as the President: **A sitting President or Vice-President of India/Governor of any state/A minister of the Union or of any State.**

Eligibility for re-election

A person, who holds or who has held office as President shall be eligible for re-election to that office.

Impeachment of the President [Article 61]

(1) The President can be removed from his office before the expiry of his term by the process of impeachment.
(2) The President can be impeached only for the violation of the Constitution.
(3) It is a quasi-judicial procedure.
(4) The impeachment procedure can be initiated in either House of the Parliament. The resolution must be signed by at least 1/4th of the total membership of the House. Before the resolution could be passed, a 14-day notice must be given to the President. Such a Resolution must be passed by a majority of not less than 2/3rd of the total membership of the House.
(5) Then, the other House of Parliament called the "Investigating House" investigates the charges by itself or cause the charge to be investigated.
(6) The President has the right to appear & to be represented at such investigation to defend him.
(7) If, as a result of the investigation the other House also passes a resolution supported by not less than 2/3rd of the total membership of House, the President stands removed from his office from the date on which the investigating House passed the resolution.

Note:
(a) The elected members of the legislative assemblies of States have no role in the impeachment proceedings, while they elect the President.
(b) The nominated members of the Parliament have the right to deliberate & vote when the resolution of impeachment is

under consideration while they have no vote in the election of the President.

Vacancy filled up with Acting President

(1) In case the office of the President falls vacant due to death, resignation or impeachment the Vice-President or in his absent. Chief Justice of Supreme Court or on his absence, senior most Judge of the Supreme Court becomes President till the fresh election for the Post & new incumbent assumes office.

(2) If the President is not able to discharge his duties due to sickness or absence due to any other reasons, the Vice-President discharges the functions of the President & is entitled to the same salary, allowances & privileges which are available to the President under the constitution.

Legislative powers of President

The legislative Powers of President are as follows:

1. The President summons both the Houses of the Parliament & prorogues them. He or she can dissolve the Lok Sabha according to the advice of the Council of Ministers headed by the PM.
2. President inaugurates the Parliament by addressing it after the general elections & also at the beginning of the first session each year.
3. All bills passed by the Parliament can become laws only after receiving the assent of the President. The President can return a bill to the Parliament, if it is not a money bill or a constitutional amendment bill, for reconsideration. When after reconsideration, the bill is passed & presented to the President, with or without amendments; President is obliged to assent to it.
4. The President can also withhold his assent to the bill thereby exercising pocket veto.
5. When both Houses of the Parliament are not in session & if Govt. feels the need for immediate action, President can promulgate ordinances which have the same force & effect as laws passed by Parliament.

Executive powers of President

The executive powers of President are as follows:

1. The President appoints the PM, the President then appoints the other members of the Council of Ministers, distributing portfolios to them on the advice of the PM.

The President is responsible for making a wide variety of appointments. These include:

Governors of States/The Chief Justice, other judges of the Supreme Court & High Courts of India/The Attorney General/The Comptroller & Auditor General/The Chief Election Commissioner & other Election Commissioners/ The Chairman & other Members of the Union Public Service Commission/ Ambassadors & High Commissioners to other countries.

3. The President is the Commander in Chief of the Indian Armed Forces.

Financial powers

1. All money bills originate in Parliament, but only if the President recommends it.
2. He or she causes the Annual Budget & supplementary Budget before Parliament.
3. The President appoints a finance commission every five years. The President appoints a finance commission every five years.

Judicial powers

1. The president appoints the Chief Justice of the Union Judiciary & other judges on the advice of the Chief Justice.
2. The President dismisses the judges if & only if the two Houses of the Parliament pass resolutions to that effect by two-thirds majority of the members present.
3. He/she has the right to grant pardon. The President can suspend, remit or commute the death sentence of any person.

Pardon - completely absolves the offender
Reprieve - temporary suspension of the sentence
Commutation - substitution of one form a punishment for another form which is of a lighter character
Respite - awarding a lesser sentence on special ground
Remission - reducing the amount of sentence without changing its character

Diplomatic powers

All international treaties & agreements are negotiated & concluded on behalf of the President. However, in practice, such negotiations are usually carried out by the PM along with his Cabinet (especially the Foreign Minister).

Military powers

The President is the supreme commander of the defense forces of India. The President can declare war or conclude peace, subject to the approval of parliament. All important treaties & contracts are made in president's name.

Emergency powers

The President can declare three types of emergencies: national, state & financial.

Vice President of India

The Vice-President is elected by an electoral college consisting of members of both Houses of Parliament, in accordance with the system of proportional representation by means of the single transferable vote & the voting in such election is by secret ballot. The Electoral College to elect a person to the office of the Vice-President consists of all members of both Houses of Parliament.

The Vice-President should not be a member of either House of Parliament or of a House of a Legislature of any state. If a member of either House of Parliament or of a House of a Legislature of any state is elected as Vice-President, he is deemed to have vacated his seat in that House on the date he/she enters his office as Vice-President.

A person cannot be elected as Vice-President unless she/he-

- is a citizen of India has completed the age of 35 years
- is qualified for election as a member of the Council of States (Rajya Sabha).
- Holds any office of profit under the Govt. of India or a State Govt. or any subordinate local authority.

Removal of Vice President

The Constitution states that the Vice President can be removed by a resolution of the Rajya Sabha passed by an absolute majority (more than 50% of total membership) & agreed to by a simple majority (50% of voting members) of the Lok Sabha (Article 67(a)).

Powers & functions of a VP

The functions of Vice-President are twofold:

1. He acts as the ex-officio Chairman of Rajya Sabha. In this capacity, his powers & functions are similar to those of the Speaker of Lok Sabha.
2. He acts as President when a vacancy occurs in the office of the President due to his resignation, removal, death or otherwise. He can act as President only for a maximum period of six months, within which a new President has to be elected. Further, when the sitting President is unable to discharge his functions due to absence, illness or any other cause, the Vice-President discharges his functions until the President resumes his office.

While acting as President or discharging the functions of President, the Vice-President does not perform the duties of the office of the chairman of Rajya Sabha. During this period, those duties are performed by the Deputy Chairman of Rajya Sabha.

- If the offices of both the President & the Vice-President fall vacant by reason of death, resignation, removal etc the Chief Justice of India or in his absence the seniormost judge of the Supreme Court acts as President.
- For the first time, during the 15-day visit of Dr. Rajendra Prasad to the Soviet Union in June 1960, the then Vice-President Dr. Radhakrishnan acted as the President.
- For the first time, in 1969, when the President Dr. Zakir Hussain died & the Vice-President V.V. Giri resigned, the Chief Justice Md. Hidayatullah acted as President.

PM

In the scheme of parliamentary system of government provided by the Constitution, the President is the nominal executive authority & PM is the real executive authority. The President is the head of the State while PM is the head of the government.

Appointment of the PM

Article 75 says that the PM shall be appointed by the President. The President appoints the leader of the majority party in the Lok Sabha as the PM. But, when no party has a clear majority in the Lok Sabha, then the President may exercise his personal discretion in the selection & appointment of the PM.

Term

The term of the PM is not fixed & he holds office during the pleasure of the President. So long as the PM enjoys the majority support in the Lok Sabha, he cannot be dismissed by the President. However, if he loses the confidence of the Lok Sabha, he must resign or the President can dismiss him.

Powers & functions of PM

- He recommends persons who can be appointed as ministers by the President.
- He can recommend dissolution of the Lok Sabha to the President at any time.
- He is the chairman of the NITI Aayog, National Development Council, National Integration Council, Inter-State Council & National Water Resources Council.

Central Council of Minister

As the Constitution of India provides for a parliamentary system of government modelled on the British pattern, the council of ministers headed by the PM is the real executive authority. Article 74 deals with the status of the council of ministers while Article 75 deals with the appointment, tenure, responsibility, qualification, oath & salaries & allowances of the ministers.

Note:

The total number of ministers, including the PM, in the Council of Ministers shall not exceed 15% of the total strength of the Lok Sabha. [91st Constitutional Amendment Act, 2003]

The council of ministers shall be collectively responsible to the Lok Sabha. A person who is not a member of either House can also become a minister but he cannot continue as minister for more than six months unless he secures a seat in either House of Parliament (by election/ nomination). [Art. 75(5)]

The council of ministers consists of three categories: Cabinet ministers, ministers of state, & deputy ministers.

Cabinet Ministers: The cabinet ministers head the important ministries of the Central government like home, defence, finance & external affairs.

Ministers of State: The ministers of state can either be given independent charge of ministries/departments or can be attached to cabinet ministers.

Deputy Ministers: The deputy ministers are not given independent charge of ministries/departments & always assist the Cabinet or State Minister or both. They are not members of the cabinet & do not attend cabinet meetings.

Minister may be taken from members of either House & minister who is member of one House has the right to speak & take part in the proceedings of the other House but cannot vote in the House of which he is not member. [Art. 88]

PARLIAMENT OF INDIA

The House of the People (Lok Sabha)

The Lok Sabha is the popular house of the parliament because its members are directly elected by the common electorates of India. All the members of this House are popularly elected, except not more than two from the Anglo-Indian community, who can be nominated by the President. In the Constitution, the strength of the Lok Sabha is provisioned under Art. 81 to be not more than 552 (530 from the States, 20 from the Union Territories & 2 may be nominated from the Anglo-Indian community). The Govt. has extended this freeze in the Lok Sabha seats till the year 2026 by Constitution (84th Amendment Act, 2001).

Special Powers of the Lok Sabha

1. Money & Financial Bills can only originate in the Lok Sabha.
2. In case of a Money Bill, the Rajya Sabha has only the right to make recommendation & the Lok Sabha may or may not accept the recommendation. Lok Sabha enjoys exclusive legislative jurisdiction over the passage of the Money Bills.
3. The Council of Ministers are responsible only to the Lok Sabha & hence the Confidence & No-confidence motions can be introduced in this House only.

4. Under Art. 352, the Lok Sabha in a special sitting can disapprove the continuance of a national emergency proclaimed by the President, even if the Rajya Sabha rejects such a resolution.

Tenure of the Lok Sabha

The normal tenure of the Lok Sabha is five years. But the House can be dissolved by the President even before the end of the normal tenure. Also, the life of the Lok Sabha can be extended by the Parliament beyond the five-year term during the period of national emergency proclaimed under Art. 352.

Qualifications for the membership of Lok Sabha

1. be a citizen of India.
2. be not less than 25 years of age.
3. be a registered voter in any of the Parliamentary constituencies in India.
4. should not hold any office of profit
5. Should not be insolvent
6. Should not be mentally unsound.

Speaker & Deputy Speaker of Lok Sabha

1) Chief presiding officer of the Lok Sabha.
2) The Speaker presides over the meetings of the House & his rulings on the proceedings of the House are final.
3) The Speaker & Deputy Speaker may be removed from their offices by a resolution passed by the House by an effective majority of the House after a prior notice of 14 days to them.
4) The Speaker, to maintain impartiality of his office, votes only in case of a tie i.e to remove a deadlock & this is known as the Casting Vote.

Special powers of the Speaker

1. Whether a Bill is Money Bill or not is certified only by the Speaker & his decision in this regard is final & binding.
2. The Speaker, or in his absence, the Deputy Speaker, presides over the joint-sittings of the parliament.
3. The committees of parliament function essentially under the Speaker & their chairpersons are also appointed or nominated by him. Members of the Rajya Sabha are also present in some of these committees.
4. If the Speaker is a member of any committee, he is the ex-officio chairman of such a committee.

Special position of the Speaker

1. Though he is an elected member of the Lok Sabha, he continues to hold his office even after the dissolution of the
2. House till a new Lok Sabha is constituted. This is because he not only presides & conducts the parliamentary proceedings but also acts as the Head of the Lok Sabha Secretariat which continues to function even after the House is dissolved.
3. The Speaker presides over the joint sitting of the two Houses of the Parliament
4. Speaker certifies a Bill as Money Bill & his decision is final in this regard.
5. The Speaker is ex-officio President of Indian Parliamentary Group which in India functions as the national group of Inter parliament Union.

***Pro tem* Speaker**

As provided by the Constitution, the Speaker of the last Lok Sabha vacates his office immediately before the first meeting of the newly elected Lok Sabha. Therefore, the President appoints a member of the Lok Sabha as the *Pro tem* Speaker. The President himself administers oath to the *Pro tem* Speaker.

The *Pro tem* Speaker has all the powers of the Speaker. He presides over the first sitting of the newly elected Lok Sabha. His main duty is to administer oath to the new members.

RAJYA SABHA

The Rajya Sabha (RS) or Council of States is the upper house of the Parliament of India. Membership is limited to 250 members, 12 of whom are nominated by the President of India for their contributions to art, literature, science, & social services.

The remainder of the body is elected by the state & territorial legislatures. Members sit for six-year terms, with one third of the members retiring every two years. The Rajya Sabha meets in continuous sessions and, unlike the Lok Sabha, the lower house of Parliament, is not subject to dissolution. The Vice President of India (currently, Hamid Ansari) is the ex-officio Chairman of the Rajya Sabha, who presides over its sessions. The Deputy Chairman who is elected from amongst the RS's members, takes care of the day-to-day matters of the house in the absence of the Chairman. The Rajya Sabha held its first sitting on 13 May 1952.

Leader of the House

Besides the Chairman (Vice-President of India) & the Deputy Chairman, there is also a function called Leader of the House. This is a cabinet minister - the PM if he is a member of the House, or another nominated minister. The Leader has a seat next to the Chairman, in the front row.

Qualifications for the membership of Rajya Sabha

(a) be a citizen of India,
(b) be 30 years of age on more,
(c) not be holding any office of profit under the central or state Govt. or local body &
(d) possess all other qualification prescribed by the act of parliament from time to time.

Powers of Rajya Sabha

It enjoys co-equal power with the Lok Sabha in respect of all bills other than money bill. In case of Money Bills, Rajya Sabha has no powers.

Exclusive Functions of Rajya Sabha

The Rajya Sabha, under Article 249, may by a special majority of two-thirds votes adopt a resolution asking the Parliament to make laws on subjects of the State list, in the national interest.

This resolution gets due attention from the Parliament. The resolution remains valid for one year only which however can be extended further in terms of another one year.

Secondly, Rajya Sabha can take steps to create All India Services by adopting resolutions supported by special majority in the national interest.

Thirdly, Rajya Sabha has the exclusive right to initiate a resolution for the removal of the Vice-President. This becomes the exclusive right of the Rajya Sabha because the Vice-President happens to be its Chairman & draws his salary as such.

DIFFERENT TERMS RELATED TO PARLIAMENT

a) Summoning

The President from time to time summons each House of Parliament to meet. But, the maximum gap between two sessions of Parliament cannot be more than six months. In other words, the Parliament should meet at least twice a year. There are usually three sessions in a year:

- the Budget Session (February to May);
- the Monsoon Session (July to September); and
- the Winter Session (November to December).

The period between the prorogation of a House & its reassembly in a new session is called 'recess'.

b) Joint Sitting

Under Article 108, there is a Provision of Joint sitting of both the Houses of the Parliament.

The Lok Sabha speaker presides over the joint sitting [Art. 118(4)].

There are only three occasions in the history of Indian Parliament that the joint sessions of the Parliament took place. They are as follows:

(i) In May 1961, for Dowry Prohibition Bill, 1959.
(ii) In May 1978 for Banking Services Commission.
(iii) In 2002 for POTA (Prevention of Terrorism Act).

Joint sitting of both Houses can be convened on two occasions:

(i) For resolving any deadlock over the passage of a Bill.
(ii) Special address by the President at the commencement of the first session after each general election of the Lok Sabha; First Session of each year (the Budget Session).

Note: Joint sitting cannot be called for resolving deadlock regarding "Money Bill" & "Constitution Amendment Bill".

c) Prorogation

The presiding officer (Speaker or Chairman) declares the House adjourned *sine die,* when the business of a session is completed. Within the next few days, the President issues a notification for prorogation of the session. However, the President can also prorogue the House while in session.

d) Adjournment

This is a short recess within a session of the Parliament, called by the presiding officer of the House. Its duration may be from a few minutes to days together.

e) Adjournment *sine die*

When the House is adjourned without naming a day for reassembly, it is called adjournment *sine die.*

Grounds for disqualification of members of Parliament

There are five grounds for disqualification of Member of Parliament.

- **Article 102(1) (a):** A Member of Parliament shall be disqualified from being a member of House, if he holds any office of profit under state other than an office declared by Parliament by law not to disqualify its holder.
- Article 102(1) (b): If the Member of Parliament is of unsound mind & stands so declared by the court of law
- Article 102(1) (c): If he is a discharged insolvent declared by court of law.
- Article 102(1) (d): If he is not a citizen of India or has acquired the citizenship of a foreign state or is under any acknowledgement of allegiance to a foreign state.
- Article 102(2): If a person is disqualified being a Member of Parliament under anti-Defection Law (Tenth Schedule).

Legislative procedures in Parliament

The legislative procedure is identical in both the Houses of Parliament. Every bill has to pass through the same stages in each House. **A bill is a proposal for legislation & it becomes an act or law when duly enacted**.

Bills introduced in the Parliament are of two kinds: **public bills & private bills** (also known as government bills & private members' bills respectively). Though both are governed by the same general procedure & pass through the same stages in the House, they differ in various respects.

BILLS IN PARLIAMENT

The four kinds of bills mentioned in the Constitution are:

- Ordinary Bill
- Money Bill
- Financial Bill
- Constitutional Amendment Bill

Ordinary Bill

Any bill other than Money, Financial or Constitution Amendment bill is called an Ordinary bill. It can be introduced in either Houses of the Parliament. It does not need the recommendation of the President for its introduction in Parliament (except a bill under article 3). It is passed by a simple majority by both the Houses. They enjoy equal legislative powers over the passage of an ordinary bill. If there is a deadlock over the bill it can be resolved in a joint sitting of both the Houses of Parliament.

Money Bill

A bill that deals exclusively with money matters that are mentioned in Article 110 in Constitution is called a Money Bill. These Money matters are:

(1) Imposition, abolition or alternation of any tax.
(2) The borrowing of any money or giving any guarantee by the Govt. of India.
(3) The custody of the Consolidated Fund of India or Contingency fund of India or deposition or withdrawal of any money from any such funds.
(4) The appropriation of the money out of the Consolidated Fund of India.
(5) Declaring any expenditure as charged on the Consolidated Fund of India.
(6) The receipt of money on the account of consolidated Fund of India or Public Account of India.
(7) Any matter that is incidental to the above matters.

A money bill can be introduced only in Lok Sabha on the recommendation of the President. It is passed by a simple

majority by both the Houses of Parliament. The Lok Sabha enjoys overriding legislative power in the passage of a money bill & Rajya Sabha cannot reject or approve a money bill by virtue of its own legislative power. Any money bill shall bear the certificate of speaker that it is a money bill. The Speaker's decision in this regard is final & binding & cannot be questioned in any court of law.

A money bill is transmitted to Rajya Sabha after it has been passed by Lok Sabha. The Rajya Sabha can exercise any of the following four options:

(i) It also passes the bill.
(ii) It rejects the bill outright – upon being rejected the bill is deemed to have been passed by both the Houses.
(iii) The Rajya Sabha does not pass the bill for 14 days, then on the expiry of 14th day after having received the bill it is deemed to have been passed by both the Houses.
(iv) The Rajya Sabha suggests amendments to the bill, the bill then goes back to the power House. If the Lok Sabha accepts one or more of the amendment then the bill is deemed to have been passed in that form on the other hand if Lok Sabha rejects the amendment then the bill is deemed to have been passed in its original form.

There is no deadlock between the Houses over the passage of a money bill. When a money bill is presents to the President, under the Constitution he shall declare that he give assent or withhold assent.

Financial Bill

A Bill apart from dealing with one or more money matters if also deals with one or more non-money matters then it is called a financial Bill. It is introduced in the same manner as that of money Bill. Since it contains non-money matters after its introduction, it is passed in same manner an ordinary bill is passed.

Constitutional Amendment Bill

A bill introduced under article 368 to amend one or more provisions of the Constitution is called a Constitutional Amendment Bill. It can be introduced in either House of the Parliament. It does not require the recommendation of President for its introduction. It shall be passed by both the House of the Parliament sitting separately by majority of not less than 2/3rd of members present & voting & a majority of total strength of the House. The Constitution does not provide for a joint sitting of both the Houses of the Parliament if a deadlock develop between the two Houses over the passage of a Constitutional Amendment Bill.

The 101 Amendment: Amendment of article 248, 249, 250, 268, 269, 270, 271, 286, 366, 368, sixth schedule, seventh schedule. Deletion of Article 268A. It was enforced since 8 September 2016. It is related to the Goods and Services Tax Bill.

Veto power of the President:

A bill passed by the Parliament can become an act only if it receives the assent of the President. However, the President has the veto power over the bills passed by the Parliament, i.e. he can withhold his assent to the bills.

- **Absolute Veto**

It refers to the power of the President to withhold his assent to a bill passed by the Parliament. The bill then ends & does not become an act. Usually, this veto is exercised in the following two cases:

a) With respect to private members' bills; &
b) With respect to the government bills when the cabinet resigns (after the passage of the bills but before the assent by the President) & the new cabinet advises the President not to give his assent to such bills.

- **Suspensive Veto**

The President exercises this veto when he returns a bill for reconsideration of the Parliament. However, if the bill is passed again by the Parliament with or without amendments & again presented to the President, it is obligatory for the President to give his assent to the bill. The President does not possess this veto in the case of money bills.

- **Pocket Veto**

In this case, the President neither ratifies nor rejects nor returns the bill, but simply keeps the bill pending for an indefinite period. This power of the President not to take any action (either positive or negative) on the bill is known as pocket veto. There is no time limit for the President to give comment on bills under this veto.

Emergency provisions in India

Emergency provisions are adopted in India from Weimar Constitution of Germany.

In Indian constitution there are three kind of emergency provisions:

(1) Article 352 – National Emergency
(2) Article 356 – President's Rule
(3) Article 360 – Financial Emergency

National Emergency (Article 352)

a) If the President is satisfied that there exist a grave emergency whether due to war or external aggression or armed rebellion, then President can proclaim emergency to that effect. Such a proclamation can be made for the whole of India or any part thereof. The President can proclaim National Emergency only on the written advice of the Cabinet.
b) The President has power to revoke or modify the National Emergency. All such proclamations of Emergency shall have to be sent to Parliament for approval & it ceases to be operational if not approved within 1 month of the proclamation of Emergency. Such approval by Parliament is to be on the basis of Special Majority of not less than 2/3rd of members present & voting & the majority of the House. Emergency shall be imposed for not more than 6 months from the date of approval.
c) At the expiry of 6 months it ceases unless approved by Parliament again. If Lok Sabha is dissolved then proclamation of Emergency, it must be approved by the Rajya Sabha within 1 month & reconstituted Lok Sabha must approve within 1 month of its reconstitution.
d) Lok Sabha enjoys powers to disapprove continuation of Emergency at any stage. In such case if not less than 1/10th of members (55) of Lok Sabha give in writing to the

Speaker if Lok Sabha is in session or to the President if Lok Sabha is not in the session, expressing intention to more resolution for the disapproval of National Emergency. Then special session of Lok Sabha shall be convened within 14 days. If Lok Sabha disapproves continuance of National Emergency then President shall have to revoke National Emergency.

Emergency in States on President's Rule (Article 356)

Under Article 356 if the President is satisfied on the report of Governor or otherwise that there exists a grave situation in a State where the administration of the State cannot be carried out in accordance with provisions of Constitution, than he can:

(a) Takeover the administration of the State himself and

(b) Notify that the Parliament shall exercise jurisdiction over State subject for the State concerned, the President cannot take over the powers conferred on the High Courts of State concerned.

Every proclamation made under Article 356 ceases to be in operation unless approved by both Houses of the Parliament within 2 months after its proclamation. Once, approved by Parliament, Emergency shall be enforced for not more than 6 months from the date of proclamation by the President.

Such an approval by the Parliament needs only simple Majority. If Lok Sabha stands dissolved then Rajya Sabha shall have to approve it within 2 months & Lok Sabha shall approve it within 1 month of its reconstitution. However, Parliament can extend it for a further period of 6 months only.

If it has to approve beyond 1 year then two conditions shall have to be satisfied.

- There shall be National Emergency in force either in whole of the State concerned on in part thereof.
- Election Commission is satisfied that under prevailing conditions general election to State Legislative Assembly of the State concerned cannot be held.

But under no circumstances, State Emergency cannot be extended beyond 3 years. To extend it further, constitutional amendment is required.

Financial Emergency

Under Article 360 the President enjoys the power to proclaim the financial Emergency. If he is satisfied that a situation has arisen that financial stability & credit of India or any part thereof is threatened he may proclaim emergency to that effect.

All such proclamations:

(a) Can be varied or revoked by the President.

(b) Financial Emergency must be approved by the Parliament within 2 months after its proclamation. Once it is approved, it will remain till the President revokes it.

Effects of Financial Emergency

(1) President is empowered to suspend the distribution of financial resources with States.

(2) President can issue directions to States to follow canons of financial propriety.

(3) He can direct State Govt. to decrease salaries allowances of Civil Servants & other Constitutional dignitaries.

(4) President can direct the Govt. to resume all the financial & Money Bills passed by legislature for his consideration. The President can issue directions for the reduction of salaries & allowances of Judges of the Supreme Court & the High Courts.

STATE LEGISLATURE

The State Legislature Legislative Assembly (Vidhan Sabha)

The Vidhan Sabha or the Legislative Assembly is the lower house of the state legislature in the different states & for the two of the union territories, Delhi & Pondicherry. Members of a Vidhan Sabha are direct representatives of the people of the particular state as they are directly elected by the adult suffrage. Each Vidhan Sabha is formed for a five year term after which all seats are up for election. The maximum size of Vidhan Sabha is not more than 500 members & not less than 60. However, the size of the Vidhan Sabha can be less than 60 members through an Act of Parliament, such is the case in the states of Goa, Sikkim & Mizoram. The Governor can appoint one member to represent the Anglo-Indian community if he or she finds that community to not be adequately represented in the House.

Qualification to be a member of Vidhan Sabha

1. To become a member of a Vidhan Sabha:
2. A person must be a citizen of India
3. She/he must have attained 25 years of age.
4. She/he should be mentally sound & should not be bankrupt.
5. She/he should also state an affidavit that there are no criminal procedures against him.

Vidhan Sabha via-a-vis Lok Sabha

The position of Vidhan Sabha is relatively stronger than Lok Sabha when it comes to the relation with the respective upper houses. The following are differences in the legislative procedures:

1. In case of Bills other than money Bills the position of Vidhan Sabha is stronger as compared to Lok Sabha. While disagreement between the two Houses of the Union Parliament is resolved by "Joint Sitting", there is no such provision of solving the deadlock at the state level. The upper house at the state level can just delay the bill for the maximum period of 4 months i.e. 3 months in first journey & 1 month in second journey.
2. While the period for passing a Bill (other than money Bill) from Rajya Sabha is six months is the case of Legislative Councils it is just three months.

Legislative Council (Vidhan Parishad)

The Legislative Council is a permanent body that cannot be dissolved; each Member of the Legislative Council (MLC) serves for a six-year term, with terms staggered so that the terms of one-third of a Council's members expire every two years. This arrangement parallels that for the Rajya Sabha, the upper house of the Parliament of India. Six states in India have a Legislative Council: Andhra Pradesh, Bihar, Jammu & Kashmir, Karnataka, Maharashtra, & Uttar Pradesh.

Qualification to be a member of Vidhan Parishad

- She/he must be citizen of India

- She/he must have attained at least 30 years of age
- She/he must be mentally sound,
- She/he must not be a bankrupt
- She/he must be listed the voters' list of the state for which he or she is contesting an election.

Election of members of Legislative Council

- One-third of the members are elected by members of local bodies such as corporations, municipalities, & Zilla Parishads.
- One-third of the members are elected by members of Legislative Assembly from among the persons who are not members of the Assembly.
- One-twelfth of the members are elected by the persons who are graduates of three years' standing residing in that state.
- One-twelfth are elected by persons engaged for at least three years in teaching in educational institutions within the state not lower than secondary schools, including colleges & universities.
- One-sixth are nominated by the governor from persons having knowledge or practical experience in fields such as literature, science, arts, the co-operative movement & social service.

Governor

The Governor is merely appointed by the President which really means, by the Union Council of Ministers. The Governor holds office during the pleasure of the President, there is no security of his tenure. He can be removed by the President at any time. There is no impeachment process for removal of Governors as prescribed in constitution in the case of President.

The powers of Governors

Executive Powers

- The Governor appoints the Chief Minister who enjoys the support of the majority in the Vidhan Sabha.
- The Governor also appoints the other members of the Council of Ministers & distributes portfolios to them on the advice of the Chief Minister.
- He/she also appoints the Advocate General & the chairman & members of the State Public Service Commission.
- The Governor appoints the judges of the District Courts.

Legislative Powers

- Summons the sessions of both houses of the state legislature & prorogues them.
- Inaugurates the state legislature by addressing it after the assembly elections & also at the beginning of the first session every year.
- Can even dissolve the Vidhan Sabha. These powers are formal & the Governor while using these powers must act according to the advice of the Council of Ministers headed by the Chief Minister.
- The Governor's address on these occasions generally outlines new policies of the state Govt.
- A bill that the state legislature has passed can become a law only after the Governor gives assent.
- Can return a bill to the state legislature, if it is not a money bill, for reconsideration
- Has the power to reserve certain bills for the President.
- When the state legislature is not in session & the Governor considers it necessary to have a law, then the Governor can promulgate ordinances.

Financial Powers

- Money bills can be introduced in the State Legislative Assembly only on the prior recommendation of the Governor.
- Governor also causes to be laid before the State Legislature the annual financial statement which is the State Budget.
- Further no demand for grant shall be made except on his/her recommendation.
- He can also make advances out of the Contingency Fund of the State to meet any unforeseen expenditure.
- Governor constitutes the State Finance Commission

Discretionary Powers

There are situations when the Governor has to act as per his/her own judgment & take decisions on his own. Such powers are called discretionary Powers:

- When no party gets a majority in the Vidhan Sabha, the Governor can either ask the leader of the single largest party or the consensus leader of two or more to form the Govt.. The Governor then appoints the leader of the largest party to Chief Minister.
- The Governor can send a report to the President informing him or her that the State's constitutional functioning has been compromised & recommending the President impose "President's rule" upon the state.
- Governor can reserve any Bill for the President.

Governor's power of Veto

When a Bill is presented before the Governor after its passage by the house(s) of the state legislature, the Governor may take any of the following steps:

1. He may declare his assent to the Bill
2. He may declare that he withholds his assent to the Bill
3. He may (in case of a Bill other than money Bill), return the Bill with a message
4. The Governor may also reserve a Bill for the consideration of President

The President enjoys absolute veto in the case of Bills reserved for him by the Governors. The president may act in the following manner:

1. In case of money Bill President may either declare his assent or withhold his assent.
2. In the case of Bills other than money Bill the President apart from declaring his assent or refusing it, direct the Governor to return the Bill to the Legislature for recommendations in such cases.

Local Self-Governance

Panchayati Raj

- The Panchayati Raj System is the **first tier** or level of democratic government.
- The term Panchayati Raj in India signifies the system of rural local self-government. It was constitutionalized through the **73rd Constitutional Amendment** Act of 1992.

- The development of the village was the immediate problem faced by our country after independence. Hence the **Community Development Programme** was launched in 1952 with a view to carrying out the integral rural development work.
- **Rajasthan** was the first state to set up Panchayati Raj System in 1959 followed by Andhra Pradesh.

Main Provisions of 73rd Amendment Act

- This act has added a new **Part-IX** to the Constitution of India.
- It is entitled as 'The Panchayats' & consists of provisions from **Articles 243(A) to 243 (O)**. In addition, the act has also added a new **Eleventh Schedule** to the Constitution. It contains 29 functional items of the panchayats.
- Fixing tenure of five years for Panchayats at all levels & holding fresh elections withing six months in the event of supersession of any Panchayat.
- Reservation of 1/3 seats (both members & chiarpersons) for women in Panchayats at all the levels.
- The Act provides for a three-tier systerm of the Panchayati Raj in the states namely:

(i) **Gram Panchayat** at the Village level.
(ii) **Panchayat Samiti** at the Block level.
(iii) **Zila Parishad** at the District level.

Compulsory Provisions for Panchayati Raj Institutions

1. Organisation of Gram Sabha in a village or group of villages.
2. Establishment of Panchayats at the village, intermediate & district levels.
3. **21 years** to be the minimum age for contesting elections to Panchayats.
4. Reservation of seats (both members & chairpersons) for SCs & STs in Panchayats at all the three levels.
5. Reservation of **one-third seats** (both members & chairpersons) for women in Panchayats at all the three levels.
6. Fixing tenure of **five years** for Panchayats at all levels & holding fresh elections within six months in the event of supersession of any Panchayat.
7. Establishment of a **State Election Commission** for conducting elections to the Panchayats.
8. Constitution of a **State Finance Commission** after every five years to review the financial position of the panchayats.

Organisational Struture

(i) Gram Panchayat at the Village level

The members of the Gram Panchayat are elected by the Gram Sabha. The **Pradhans** (Presidents) of the Gram Sabha are the ex-officio members of the Gram Panchayat. **Note: Gram Sabha** means a body consisting of persons registered in the electoral roles relating to a village comprised within the area of Panchayat at the village level.

(ii) Panchayat Samiti at the Block level

The Panchayat Samiti has many Gram Panchayats under it. All the Presidents of the Panchayats within the Block are the *ex officio* members of the 'Panchayat Samitis'.

(iii) Zila Parishad at the District level

- Zila Parishad is an apex body under the Panchayati Raj. It co-ordinates the activities of the various Panchayat Samitis.
- Zila Parishad actually makes developmental plans at the district level.
- With the help of Panchayat Samitis, it also regulates the money distribution among all the Gram Panchayats.

Supreme Court of India

Supreme Court of India is the highest judicial forum & final court of appeal. According to the Constitution of India, the role of the Supreme Court is that of a federal court & guardian of the Constitution.

Composition of Supreme Court

Under Article 124(1) the constitution originally provided for 1 Chief Justice of India & not more than 6 other judges. The constitution authorizes the Parliament to provide by law in fixing the Strength of the judges of the Supreme Court.
The Parliament passed the Supreme Court (Number of Judges) thus accordingly, a Constitutional Amendment Act in 2008 has increased the strength of Supreme Court to 31 (1 Chief Justice + 30 other judges).

Qualification to be a judge of Supreme Court

1. A person must be a citizen of India
2. He/she must have been, for at least five years, a Judge of a High Court or of two or more such Courts in succession
3. Or an Advocate of a High Court or of two or more such Courts in succession for at least ten years
4. Or the person must be, in the opinion of the President, a distinguished jurist.

Removal of judges of Supreme Court

Article 124(4) provides for the removal of a judge of the Supreme Court. He is removed by the President upon an address by both the Houses of the Parliament supported by a majority of not less than 2/3rd of members present & voting & a majority of total strength of the House on the ground of misbehavior or incapacity.

The President shall pass the order of removal in the same session in which the Parliament passed the resolution.
Article 124(5) confers the power on the Parliament to provide by law for the procedure for the Presentation of an address & for the investigation for proof of misbehavior or incapacity of a judge. Accordingly the Parliament passed Judges (Inquiry) Act 1968 which states that a resolution seeking the removal of a judge of
Supreme Court can be introduced in either House of Parliament.

- It should be supported by not less than 100 member of Lok Sabha.
- If it is to be introduced in Rajya Sabha it should be supported by no less than 50 members of Rajya Sabha.
- Once the resolution is initiated in either house of the parliament, the presiding officer of that House shall appoint a three member Judicial Committee to investigate into charges & provide proof of misbehavior or incapacity.
- The judicial committee shall be headed by a serving judge of the Supreme Court. Second member can be a serving

judge of the High Court & the third member can be an eminent jurist.

- The Court divided the entire process of removal of a judge into two parts mainly Judicial Act & Political Act. Whenever the authority concerned does not enjoy discretionary power it is called Judiciary act & the judge concerned does not enjoy the right to be heard in such cases.

The judicial parts consist of:

1. The presiding officer appointing a three member judicial committee.
2. Judicial committee investigating the charges.
3. The President passing the order of removal of a Judge Whereas the political parts consist of:
1. Introduction of resolution in Parliament.
2. Houses of Parliament passing the resolution.

The Court also clarified that the Parliament is not bound to pass the resolution even if the judicial committee establish proof of misbehavior or incapacity. However, if the Judicial Committee failed to provide proof of misbehavior or incapacity, the Parliament cannot take up the resolution process further.

SUPREME COURT IN INDIA(JURISDICTION)

It is the highest judicial forum & final court of appeal as established by Part V, Chapter IV of the Constitution of India. Articles 124 to 147 of the Constitution of India lay down the composition & jurisdiction of the Supreme Court of India. The Supreme Court has Original jurisdiction, Appellate jurisdiction & Advisory jurisdiction. The Supreme Court is the highest appellate court which takes up appeals against the verdicts of the High Courts & other courts of the states & territories.

The Supreme Court has the power to transfer the cases from one High Court to another & even from one District Court of a particular state to another District Court of the other state. The Supreme Court has the power of Constitutional review. The Supreme Court of India held its inaugural sitting on 28 January 1950.

Salary-Article 125 of the Indian Constitution leaves it to the Indian Parliament to determine the salary, other allowances, leave of absence, pension, etc. of the Supreme Court judges. However, the Parliament cannot alter any of these privileges & rights to the judge's disadvantage after his appointment. A judge gets ₹90,000 & the Chief Justice gets a sum of ₹1,00,000. **Some Important Points on SC**

1. The first woman judge of the Supreme Court was Justice Fatima Beevi in 1987. However, there has been no female Chief Justice
2. Ad hoc Judges:

a) Ad hoc Judges are non-Supreme Court judges who sit in the Supreme Court when there is insufficient quorum to perform the judicial duties.
b) Ad hoc Judges are appointed by the Chief Justice after obtaining consent from the President.
c) Serving(HC) & retired(SC & HC) judges of the Supreme Court (and High Courts) can sit & act as ad hoc Judges of the Supreme Court.
d) Only such persons can be appointed as ad hoc Judges who are qualified to be appointed as a regular Judge of the Supreme Court

3. The Chief Justice administers the oath infront of the President.
4. The first Chief Justice of India was H J Kania (1950 – 1951).
5. The shortest tenure was for K N Singh (Nov 1991 – Dec 1991, UP)
6. The longest tenure was for Y V Chandrachud (1978 – 1985, Bombay)

JURISDICTION OF THE SUPREME COURT:

a) Original Jurisdiction:

1. Original Jurisdiction means that certain types of cases can originate with the Supreme Court only
2. The Supreme Court has original jurisdiction in

a) Disputes between the Centre & one or more states.
b) Disputes between the Centre & any state(s) on one side & one or more states on the other side.
c) Disputes between two or more states.
d) Disputes regarding the enforcement of Fundamental Rights.

b) Appellate Jurisdiction:

Appellate Jurisdiction means that appeals against judgements of lower courts can be referred to SC as the Supreme Court is the highest court of appeal in the country.

c) Advisory Jurisdiction:

1. Advisory Jurisdiction refers to the process where the President seeks the Court's advice on legal matters.
2. If the President asks for advice from the Supreme Court, the Court is duty-bound to give it. However, it is not binding on the President to accept the advice.

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HIGH COURT

1) The High Court is at the apex of the judicial administration of the state.
2) Art 214 of the Constitution provides that there shall be a High Court for each state of the Indian union. But the Indian Parliament is empowered to establish a common High Court for two or more states & to extend the jurisdiction of a High Court to a union territory. Similarly, Parliament can also reduce the area of jurisdiction of a High Court.
3) The High Court consists of a Chief Justice & some other Judges. The number of judges is to be determined by the President of Indian from time to time.
4) The Chief Justice of a High Court is appointed by the President in consultation with the Chief Justice of the Supreme Court & the Governor of the state concerned. The procedure for appointing other judges is the same except that the Chief Justice of the High Court concerned is also consulted. HC JUDGE hold office until they attain the age of 62 years & are removed from office in the same manner as a judge of the Supreme Court.

Qualification

A person shall be qualified for appointment as a judge of the High Court if

(a) he is a citizen of India,
(b) has for at least ten yeas held a judicial office in the territory of India, or
(c) has for at least ten years been an advocate of a High Court, or of two or more such courts in succession.

Every judge of the High Court before entering upon his office shall make & subscribe before the Governor of the state, an oath of affirmation in the form prescribed by the Constitution.

Removal of judges

A judge of the High Court shall hold office until he attains the age of 62 years. A judge may resign from his office by writing under his hand to the president of India. He can also be removed by the President of India on the ground of proved misbehavior or inefficiency if a resolution to that effect is passed by both the Houses of Parliament by a two-thirds majority of the total members present & voting, supported by a majority of the total membership of each house.

Jurisdiction of a HC

The High Court has Original jurisdiction in such matters as writs & Appellate jurisdiction over all subordinate courts in their jurisdiction. Every High court has the power to issue to any person or authority including any Govt. within its jurisdiction, direction, or orders including writs which are in the nature of habeas corpus, mandamus prohibition, qua-warranto & certiorari or any of them for enforcement of fundamental rights conferred by part III of the constitution & for any other purpose.

1) Election petitions challenging the elections of Members of Parliament or member of State Legislative Assembly or other local bodies can be filed in the concerned High Court.
2) The High Courts have Appellate jurisdiction in both civil & criminal cases against the decisions of lower courts.

Under Revisory jurisdiction, the High Court is empowered to call for the records of any court to satisfy itself about the correctness of the legality of the orders passed. This power may be exercised on the petition of the interested party or it can suo moto call for the records & pass necessary orders.

All Courts excepting tribunals dealing with the Armed forces, are under the supervision of the High Court.Tribunals dealing with the Armed forces are not under the supervision of HC.

This power is enjoyed under Art 227 of the Constitution. Thus administration of the state's judiciary is the essential function of the High Court.

Writs in Indian Constitution

As per the Right to Constitutional Remedies-Articles 32-35, A citizen has right to move to the courts for securing the fundamental rights. Citizens can go to the Supreme Court or the high Courts for getting their fundamental rights enforced. It empowers the Courts to issue directions or orders or writs for this purpose. Writs are issued for enforcement of FUNDAMENTAL RIGHTS BY EITHER SC or HC.

Types of Writs:

1. **Writ of Habeas Corpus:**
   (a) Habeas Corpus means 'you may have the body'.
   (b) This ensures that a prisoner can be released from unlawful detention—that is, detention lacking sufficient cause or evidence.
2. **Writ of Quo Warranto:**
   (a) The meaning of the term Quo Warranto is 'by what authority'.
   (b) The writ shall be issued only when the public office is held by a particular person in an illegal manner.
   (c) If a person has usurped a public office, the Court may direct him not to carry out any activities in the office or may announce the office to be vacant.
3. **Writ of Mandamus:**
   (a) A writ of mandamus is an order issued by a superior court to a lower court or other entity commanding the lower court, corporation or public authority to perform or not perform specific acts.
   (b) It cannot be issued to compel an authority to do something against statutory provision.
4. **Writ of Certiorari:**
   (a) It is a writ (order) of a higher court to a lower court to send all the documents in a case to it so the higher court can review the lower court's decision.
   (b) It is a writ seeking judicial review.
   (c) Granting a writ of certiorari means merely that at least four of the justices have determined that the circumstances described in the petition are sufficient to warrant review by the Court.
5. **Writ of Prohibition :**
   (a) A writ of prohibition is issued primarily to prevent an inferior court from exceeding its jurisdiction.
   (b) These Writs are issued as "alternative" or "peremptory." An alternative Writ directs the recipient to immediately act, or desist, & "Show Cause" why the directive should not be made permanent. A peremptory Writ directs the recipient to immediately act, or desist, & "return" the Writ, with certification of its compliance, within a certain time.
   (c) The writ can be issued only when the proceedings are pending in a court if the proceeding has matured into decision, writ will not lie.

Union Territories

- **Articles 239 to 241** in Part VIII of the Constitution deal with the union territories. Even though all the union territories belong to one category, there is no uniformity in their administrative system.
- Every union territory is administered by the president acting through an administrator appointed by him. An administrator of a union territory is an agent of the president & not head of state like a governor.
- The president can specify the designation of an administrator; it is Lieutenant Governor in the case of Delhi, Puducherry & Andaman & Nicobar Islands & Administrator in the case of Chandigarh, Dadra & Nagar Haveli, Daman & Diu & Lakshadweep.
- The Parliament can make laws on any subject of the three lists (including the State List) for the union territories. This

power of Parliament also extends to Puducherry & Delhi, which have their own local legislatures but the legislative assembly of both (Delhi & Puducherry) can also make laws on any subject of the State List & Concurrent List. This means that the legislative power of Parliament for the union territories on subjects of the State List remain unaffected even after establishing a local legislature for them.

Special Status of Jammu & Kashmir

Article 370 in Part XXI of the Constitution grants a special status to it. Accordingly, all the provisions of the Constitution of India do not apply to it. It is also the only state in the Indian Union which has its own separate Constitution.

The important features of the special state are as follows:

1. Contrary to the case with the other states, the residuary power lies with the legislature of the Jammu & Kashmir (and not the Parliament).
2. The state has its own Constitution. This also implies that 'dual citizenship' principle is followed in this state.
3. Part-IV (Directive Principles of State Policy) & Part- IV(A) (Fundamental Duties) are not applicable to the state.
4. The National Emergency proclaimed only on the ground of war or external aggression shall have automatic extension to the state of J&K. This means that the National Emergency proclaimed on the ground of armed rebellion shall not have automatic extension to J&K.
5. Financial Emergency (Art 360) cannot be imposed on the state.
6. Art. 19(1) & 31(2) have not been abolished for this state & hen ce "right to property" still stands guaranteed to the people of J&K.
7. The Parliament is not empowered to make laws on the subjects of state list (7th schedule) for the state of J&K under any circumstance.
8. The Governor of the state is to be appointed only after consultation with the Chief Minister of that state.

GOVENRNMENT BODIES

1) Election Commission

- The Election Commission is a permanent, independent body established by the Constitution of India directly to ensure free & fair elections in the country. Article 324 of the Constitution provides that the power of superintendence, direction & control of elections to parliament, state legislatures, the office of president of India & the office of vice-president of India shall be vested in the election commission.
- Elections are conducted according to the constitutional provisions supplemented by laws made by Parliament.
- The major laws are Representation of the People Act, 1950, which mainly deals with the preparation & revision of electoral rolls, & the Representation of the People Act, 1951, which deals in detail with all aspects of conduct of elections & past election disputes.
- The electoral system in India in borrowed from the one operating in Great Britain. Presently, the Election Commission consists of one Chief Election Commissioner (CEC) & two Election Commissioners.
- The Commission works under the overall supervision of the Chief Election Commissioner.
- The tenure of the CEC & the Election Commissioners has been fixed as six years, subject to the maximum age limit of 65 years (whichever is earlier).
- The Chief Election Commissioner & the Election Commissioners are placed at par in matters of salary & allowances & they are the same as those of a judge of Supreme Court.
- The Chief Election Commissioner is not eligible for reappointment.
- The Election Commission is not concerned with the elections to Panchayats & municipalities in the states.
- The elections to the Panchayats & the municipalities in the states are conducted by 'State Election Commissions'.

Independence of CEC

Article 324 of the Constitution has made the following provisions to safeguard & ensure the independent & impartial functioning of the Election Commission:

1. The Chief Election Commissioner is provided with the security of tenure. He cannot be removed from his office except in same manner & on the same grounds as a judge of the Supreme Court.
2. The Election Commissioner cannot be removed from office except on the recommendation of the Chief Election Commissioner.

Powers & functions

1. To determine the territorial areas of the electoral constituencies throughout the country on the basis of the Delimitation Commission Act of Parliament.
2. To prepare & periodically revise electoral rolls & to register all eligible voters.
3. To notify the dates & schedules of elections & to scrutinise nomination papers.
4. To grant recognition to political parties & allot election symbols to them.
5. To act as a court for settling disputes related to granting of recognition to political parties & allotment of election symbols to them.
6. To determine the code of conduct to be observed by the parties & the candidates at the time of elections.
7. To advise the President on matters relating to the disqualification of the members of Parliament.
8. To advise the governor on matters relating to the disqualification of the members of state legislature.
9. To cancel polls in the event of rigging, booth capturing, violence & other irregularities.
10. To register political parties for the purpose of elections & grant them the status of national or state parties on the basis of their poll performance

Union Public Service Commission

- With the promulgation of the new Constitution for independent India on 26th January, 1950, the Federal Public Service Commission was accorded a constitutional status as an autonomous entity & given the title – Union Public Service Commission.

- The UPSC has been established under Article 315 of the Constitution of India. The Commission consists of a Chairman & ten Members.
- The chairman & members of the commission hold office for a term of six years or until they attain the age of 65 years, whichever is earlier.
- It is an independent constitutional body.
- The main function of UPSC is Recruitment to services & posts under the Union through conduct of competitive examinations.

State Public Service Commission

- A state public service commission consists of a chairman & other members appointed by the governor of the state. But they can be removed only by the President.
- It is an independent constitutional body.
- The chairman & members of the commission hold office for a term of six years or until they attain the age of 62 years, whichever is earlier.
- The main function of SPSC is to conduct examin ations for appointments to the services of the state.

Joint State Public Service Commission

- The Constitution makes a provision for the establishment of a Joint State Public Service Commission (JSPSC) for two or more states.
- A JSPSC can be created by an act of Parliament on the request of the state legislatures concerned. Thus, a JSPSC is a statutory & not a constitutional body.
- The chairman of JSPSC is appointed by the President.

Comptroller & Auditor General

- The Constitution of India (Article 148) provides for an independent office of the Comptroller & Auditor General of India (CAG).
- It is the supreme audit institution of India.
- He is the head of the Indian Audit & Accounts Department & the guardian of the public purse & controls the entire financial system of the country at both the levels—the Centre & the state.

Appointment & term

- The CAG is appointed by the President of India. He holds office for a period of six years or up to the age of 65 years, whichever is earlier.
- He can resign any time from his office by addressing the resignation letter to the president. He can also be removed by the President on same grounds & in the same manner as a judge of the Supreme Court.

Main function of the CAG

1. He audits the accounts related to all expenditure from the Consolidated Fund of India & consolidated fund of each state.
2. He audits all expenditure from the Contingency Fund of India & the Public Account of India as well as the contingency fund of each state & the public account of each state.
3. He audits the accounts of any other authority when requested by the President or Governor.

Note: He submits his audit reports relating to the accounts of the Centre to President & relating to the accounts of a state to governor.

Attorney General of India

- Art. 76 states that the President shall apoint a person who is qualified to be appointed as a judge of the Supreme Court to be the Attorney General of India.
- He is the fist legal officer of the Govt. of India.
- The term of office of the AGI is not fixed by the Constitution of India.
- He holds office during the pleasure of the President & receives remuneration as the President may determine. Although, he is not a member of either House of Parliament, he enjoys the right to attend & speak in the Parliamentary deliberations & meeting (of both the Lok Sabha & the Rajya Sabha), without a right to vote.
- He advises the Government of India on any legal matter.
- He performs any legal duties assigned by the President of India.
- He discharges any functions conferred on him by the Constitution or the President.
- In the performance of his official duties, the Attorney General has the right of audience in all courts in the territory of India.
- He is entitled to all the privileges & immunities as a Member of Parliament.

Note: The Constitution (Article 165) has provided for the office of the advocate general for the states. He is the highest law officer in the state. Thus he cooresponds to the Attorney General of India. He is appointed by the Governor of the state.

Parliamentary Funds

Consolidated Fund of India

1. Article 266 has established Consolidated Fund of India.
2. It is a constitutional fund.
3. All the receipts received, loans raised & the income of the Govt. of India are deposited into a Fund called the Consolidated Fund of India.
4. It is the largest fund of the Govt. of India & any amount of money can be deposited into this account.
5. It is a regular fund of Govt. of India.
6. All expenditures of the Govt. of India are spent out of the Consolidated Fund of India.
7. It has been placed at the disposal of the Parliament. No money can be deposited into withdrawn or appropriated out of the Consolidated Fund of India without the prior sanction of the Parliament. Article 266 has also created a separate Consolidated Fund for each State.

Public Account of India

Under Article 266 any money other than the receipts, loans & the income received by the Govt. of India is deposited into an account called the Public Account of India. The Public Account of India is placed at the disposal of the President article 266 has also created public account for each states.

Contingency Fund of India

Article 267 empowers the Parliament to provide by law for the establishment of a public fund called the Contingency Fund of

India. Accordingly, the Parliament enacted the Contingency Fund of India (Misc. Provisions Act) 1950, which has created the contingency Fund of India with an upper limit of Rs. 50 Cr. It is not a regular fund of Govt. of India & it is used to meet on unforeseen expenditures of the Govt. of India. It is placed at the disposal of President who can provide the sanction for meeting an emergency expenditure out of contingency Fund of India.

The Fund is used when the Parliament is not in a position to sanction money out of Consolidated Fund of India to meet an unforeseen expenditure. The money so sanctioned out of contingency fund of India by the President is placed before the Parliament for its approval subsequently. If the Parliament approves the expenditure then the equal amount of money is transferred from Consolidated Fund of India to Contingency Fund of India. Thus the Contingency Fund is replenished by the Contingency Fund. The Parliament by law may increase the upper limit of Contingency Fund either permanently or temporarily.

Political Parties

A recognised political party has been classified either as a "national party" or a "state party". Recognition to a party is granted by the "Election Commission of India".

Conditions for Recognition as a National Party

A party is recognized as a national party if any of the following conditions is fulfilled:

1. If it wins 2% of seats in Lok Sabha at a general election;and these candidates are elected from three states; or
2. If it secures 6% of valid votes polled in any four or more states at a general elcetion to the Lok Sbha or to the legislative assembly; & in addition, it wins four seats in the Lok Sabha from any state or states; or
3. If it is recognized as state party in your states.

Important Points to look at

1. The estimate of expenditure in respect of a Ministry/Department not charged upon the Consolidated Fund of India, placed for approval before the House on the recommendations of the President -**Demand for Grant**
2. A Bill passed annually (or at various times of the year) providing for the withdrawal or appropriation from & out of the Consolidated Fund of India of moneys by Lok Sabha & moneys charged on the Consolidated Fund for the services of a financial year or a part thereof-**Appropriation Bill**
3. A motion for reduction of a demand for grant by or to a specified amount-**Cut motion**
4. Cut motion can be of three types - **Disapproval of policy cut, Economy cut & Token cut**
5. A grant made by Lok Sabha in advance in respect of the estimated expenditure of the Government of India for a part of a financial year pending the voting of Demands for Grants for the financial year. A Motion for Vote on Account is dealt with in the same way as if it were a demand for grant.-**Vote on Account**
6. The first hour of a sitting of the House normally allotted for asking & answering of questions-**Question Hour**

Motions in Parliament

(1) Private Member's business

Every member who is not a Minister is called a Private Member. The Private Member's business includes Private Member's Bills & Private Member's Resolutions. The period of notice for introduction of Bill is one month unless the Presiding officer allows introduction at a shorter notice.

(2) Question Hour

Normally, the first hour of the business of a House everyday is devoted to questions & is called Question Hour (11:00 AM to 12:00 Noon).

(3) Starred & Unstarred Questions

A starred question is one to which a member desires an oral answer in the House. Answer to such a question may be followed by five supplementary questions by other members. An unstarred question is one to which written answer is desired by the Member. No supplementary questions can be asked thereon.

(4) Short Notice Questions

These are related to matter of urgent public importance & can be asked by members with notice shorter than the 10 days prescribed for an ordinary question. It is for the Speaker to determine whether the matter is of real urgent nature or not.

(5) Adjournment Motions

An adjournment motion is an extra-ordinary procedure which if admitted leads to setting aside the normal business of the House for discussing a definite matter of Urgent Public importance.

(6) Calling Attention

It is a notice by which a member with the prior permission of the Speaker, Calls the attention of a Minister of any matter of urgent public importance & the Minister may make a brief statement or ask for time to make a statement at a later hour or date it is an Indian Innovation.

There is no calling attention Notice in the Rajya Sabha. Instead there exists a motion called 'Motion for Papers.'

(7) Privilege Motion

This motion is moved by a member if in his opinion any minister or any of the members commits a breach of privilege of the House by withholding any fact.

ARTICLES RELATED TO BILLS

- Article 107 : Provisions as to introduction & passing of Bills
- Article 108 : Joint sitting of both Houses in certain cases
- Article 109 : Special procedure in respect of Money Bills
- Article 110 : Definition of "Money Bills"
- Article 111 : Assent to Bills
- Article 112 : Annual financial statement
- Article 113 : Procedure in Parliament with respect to estimates
- Article 114 : Appropriation Bills
- Article 115 : Supplementary, additional or excess grants

- Article 116 : Votes on account, votes of credit & exceptional grants
- Article 117 : Special provisions as to financial Bills
- Article 118 : Rules of procedure
- Article 119 : Regulation by law of procedure in Parliament in relation to financial business
- Article 120 : Language to be used in Parliament
- Article 121 : Restriction on discussion in Parliament
- Article 122 : Courts not inquire into proceedings of Parliament

MODERN HISTORY

The Advent of the Europeans

Portuguese

1. Discovery of the New Sea Route "the Cape route" was discovered from Europe to India by Vasco da Gama. He reached the port of Calicut on the May 17. 1498, & was received by the Hindu ruler of Calicut (known by the title of Zamorin). This led to the establishment of trading stations at Calicut, Cochin & Cannanore. Cochin was the early capital of the Portuguese in India.Later Goa replaced it.
2. Alfonso d' Albuquerque arrived in India in 1503 as the governor of the Portuguese in India in 1509 (The first governor being Francisco de Almeida between 1503-09) . He captured Goa from the ruler of Bijapur in 1510.

Other Governors

- Nino da Cunha (1529-38)— transferred his capital from Cochin to Goa (1530) & acquired Diu & Bassein (1534) from Bahadur Shah of Gujarat.
- Martin Alfonso de Souza (1542-45) —the famous Jesuit saint Francisco Xavier arrive in India with him.
- The Portuguese rule began to decline afterwards & in the end they left only with GOA, DAMAN & DIU which they retained till 1961.

English

Before the East India Company established trade in the India,

1. John Mildenhall a merchant adventurer was the first Englishman who arrived in India in 1599 by the land route, for the purpose of trade with Indian merchants.
2. Popularly known as the 'English East India Company'. It was formed by a group of merchants known as the "Merchant Adventures' in 1599 & in 1600 the company was given rights to trade in the entire east by QUEEN ELIZABETH I.
3. Following the decision of the East India Company to open a factory at Surat (1608). Captain Hawkins arrived at Jahangir's court (1609) to seek permission. A farman was issued by Jahangir permitting the English to build a factory at Surat (1613).
4. Sir Thomas Roe came to India as ambassador of James I to Jahangir's court in 1615 to obtain the permission to trade & establish factories in different parts of the empire.

French

1. The French East India Company was formed by Colbert in 1664.
2. The first French factory was established at Surat by Francois Caron in 1664. A factory at Masulipatam was set up in 1669.
3. The French power in India was revived under Lenoir & Dumas (governors) between 1720 & 1742. They occupied Mahe in the Malabar,Yanam in Coromandal & Karikal in Tamil Nadu (1739).
4. The arrival of Dupleix as French governor in India in 1742 saw the beginning of Anglo-French conflict (Carnatic wars) resulting in their final defeat in India.

Establishment of Factories by EAST INDIA COMPANY

- The East India Company acquired Bombay from Charles II on lease. Gerald Aungier was its first governor from 1669
- to 1677. The first factory was built at Surat in (160S). Later, Surat was replaced by Bombay as the headquarters of the Company on the west coast in 1687.
- In 1639 Francis Day obtained the site of Madras from the Raja of Chandragiri with permission to build a fortified factory, which was named Fort St. George. Madras soon replaced Masulipatam as the headquarters of the English on the Coromandal coast.
- In 1690 Job Charnock established a factory at Sutanuti & the zamindari of the three villages of Sutanuti, Kalikata and Govindpur was acquired by the British (1698). These villages later grew into the city of Calcutta. The factory at Sutanuti was fortified in 1696 & this new fortified settlement was named fort William' in 1700.
- In 1694, the British Parliament passed a resolution giving equal rights to all Englishmen to trade in the East. A new rival company, known as the 'English Company of Merchants Trading to the East Indies' (1698) was formed.
- The final amalgamation of the company came in 1708 under the title of 'The United Company of Merchants of England Trading to the East Indies'. This new company continued its existence till 1858.

IMPORTANT BATTLES

The First Anglo-Mysore War (1767-69)

A tripartite alliance was formed against Haider by the British, the Nizam & the Marathas. The war ended with the defeat of British. The panic-stricken Madras government concluded the humiliating Treaty of Madras in 1769.

Treaty of Madras

It was signed by Haider Ali & the allies consisting of the Company, the Raja of Tanjore, & the Malabar ruler.

The Second Anglo-Mysore War (1780-1784)

Haider Ali arranged a joint front with the Nizam & the Marathas against the common enemy -the English East India Company.

The war lasted from 1780-1784. But he died in 1782 & was succeeded by his son Tipu Sultan.
Tipu continued the war for another year but absolute success eluded both the sides. Tired of war the two sides concluded peace **Treaty of Mangalore. By this Treaty** it was decided that English would return Srirangapatnam to Tipu & Tipu would handover Fort of Badnur to English.

Treaty of Seringapatam

It was signed by Tipu on the one hand & the English & their allies (Nizam & the Peshwa) on the other. The Treaty stipulated that:

- The earlier treaties between the English & the rulers of Mysore stood confirmed.
- Tipu was to cede half his territories where where to be shared among the three allies.
- Tipu was also to order the release of all prisoners of war.
- Pending fulfilment of these terms two of his sons were to be detained as British hostages.

The Fourth Anglo-Mysore War (1799)

With his defeat in the third Anglo-Mysore war, Tipu was burning with revenge. He wanted to get back his territory & to achieve that objective he carried on negotiations with the French & Zaman Shah of Kabul. Tipu wanted his allies to expel the English. Lord Wellesley after making Subsidiary Alliance with the Nizam asked Tipu Sultan to accept the same but he refused. Mysore was attacked from two sides. The main army under General Harris supported by Nizam's subsidiary force under Arthur Wellesley attacked Mysore from the east while another army advanced from Bombay.
Tipu was at first defeated by the Bombay army & was later on defeated by the General Harris at Mallavalli. Tipu died fighting bravely.

First Anglo Maratha War (1775-82)

The primary cause of the first Maratha war was the interference of the English government at Bombay in the internal affairs of the Marathas.Peshwa Madhav Rao died in 1772 & was succeeded by his younger brother Narain Rao.His uncle Raghoba wanted to become the Peshwa & got him murdered. The Maratha chiefs took up the cause of Madhav Rao Narain the son of Narain Rao.Ragobha approached British for help & signed the treaty of Surat hopping to gain the coveted Gaddi with the help of English subsidiary troops. By this treaty he also promised to cede Salsette & Bassein & refrain from entering into alliance with the enemies of the company.

In the war that followed nobody gained any success & two parties realized the futility of the struggle by concluding the Treaty of Salbai (1782). By the Treaty of Salbai, status quo was maintained which gave the British 20 years of peace with the Marathas. The treaty also enabled the British to exert pressure on Mysore with the help of the Marathas in recovering their territories from Haider Ali.

Second Anglo- Maratha War (1803-1806)

The second Maratha war was fought at the time of Lord Wellesley who wanted the Marathas to accept his Subsidiary Alliance system. The Marathas refused to accept it but were tricked by Wellesley due to their own internal differences. The Treaty of Bassein made conflict with the Marathas inevitable. The main provisions of the treaty were the recognition of Peshwa's claim in Poona acceptance of Subsidiary Alliance by Baji Rao II & relinquishing of all rights of Surat by Baji Rao to the British.

For Marathas Treaty of Bassein was loss of national honor. Holkar & Scindia stopped fighting. Scindia & Bhonsle combined but Holkar & Gaikwad remained aloof. Scindia & Bhonsle were asked by the English to withdraw their troops to the north of the Narmada River but they refused & it led to war. Both Scindia & Peshwar had accepted the sovereignty of the English. British turned their attention towards Holkar but Yashwant Rao Holkar proved more than a match for the British. Wellesley was recalled from India & the Company made peace with the Holkar in January 1806 by the Treaty of Rajghat giving back to the latter the greater part of the territories.

Third Anglo-Maratha War (1817-1818)

Third Anglo-Maratha War (1817-1818) Maratha made a desperate last attempt to regain their independence & prestige in 1817.This led in organizing a united front of the Maratha Chiefs & was taken over by the Peshwa who was uneasy under the rigid control exercised by the British Resident. However once again the Marathas failed to evolve any plan of action. The Peshwa attacked the British Residency at Poona in 1817, Appa Saheb of Nagpur attacked the Residency at Nagpur & Madhav Rao Holkar made preparations for war.
The Maratha confederacy was altogether destroyed so many territories were taken from its various members that they were rendered powerless to do anything against the British. Thus the work was accomplished by Lord Hastings in 1818.Now the British Government became the supreme & paramount authority in India

Siraj-ud–Daula

Siraj-ud Daula came to power in 1756.Calcutta was renamed Alinagar after its capture by Siraj-ud-Daula.He tried to control

the activities of East India Company.He wrote letters to the British governor of Calcutta to demolish additional fortifications & also to stop unlawful activities against him.
The British refused to comply with his orders & he seized the English factory at Kasimbazar & then Calcutta.In 1757,his men were attacked by English army led by Robert Clive.This forced the nawab to come to an understanding & establish peace with the English.

Treaty of Alinagar (1757)

The treaty comprised:
A list of demands made by the Company
An agreement affirming to return to status quo
A number of farmans & dastaks issued by the nawab
As long as nawab shall observe his agreement, English will continue to support him.
All the trade privileges held earlier by the Company stood confirmed. Additionally the English were authorized to fortify Calcutta against possible French attack & issue their own coins.

Battle of Plassey (23 June 1757)

The treaty was violated by conquest of Chandannagore by the British in 1757.Siraj ud –Dhaula protested by offering protection to the French. The British decided to remove him through conspiracy. The battle of Plassey took place on June 23 ,1757. This battle saw the treachery of Mir Jafar & Rai Durlabh,bravery of small force & desertation of Nawab's army.Siraj-ud –Dhaula was captured & executed by son of Mir Jafar.

Mir Jafar (1757-60)

Mir Jafar granted the right to free trade in Bengal & Bihar & Orissa & zamindari of the 24 parganas to the British besides paying them a sum of Rs 17.7 million as compensation.His period saw the beginning of the drain of wealth from India to Britain.He tried to replace the English with the Dutch but the Dutch were defeated by the English at Bedara in 1759.

Mir Qasim (1760-63)

Mir Qasim granted the zamindari of Burdwan,Midnapore & Chittagong to the British officials . He transferred his capital from Murshidabad to Mongher.He stopped the misuse of the dastaks or free passes allowed to the company & abolished all duties on internal trade against British.

Battle of Buxar

Mir Qasim fought against the British along with three allies – Shuja-ud-Daula of Awadh & Shah Alam II.This battle led to their defeat by the British forces under Major Hector Munro.

The Revolt of 1857

The Revolt of 1857 is an important landmark in the history of India. As per the British historians it was the **"Sepoy Mutiny"**, it was the **"First war of independence"**.

Immediate cause: The introduction of Enfield greased rifles whose cartridges were said to have a greased cover made of beef & pork sparked off the revolt. It agitated both Hindu & Muslim soldiers & resulted in immediate launch of movement.

1.2 The course of events

- On March 29, 1857, an Indian sepoy of 34 Native Infantry, Mangal Pandey, killed two British officers- Hugeson & Baugh-on parade at Barrackpore (near Calcutta).
- The mutiny really started at Merrut on 10th May 1857. The 3rd Native Infantry revolted. The occasion was the punishment of some sepoys for their refusal to use the greased cartridges. The soldiers alongwith other groups of civilians, went on a rampage shouting 'Maro Firangi ko'. They broke open jails, murdered Europeans, burnt their houses & marched to Delhi after sunset.
- The appearance of the marching soldiers next morning (i.e. 11th May) in Delhi was a signal to the local soldiers, who in turn revolted, seized the city & proclaimed the 82-year old Bahadur Shah 'Zafar' , as Shahenshah-i-Hindustan (i.e. Emperor of India).
- The British allies during the revolt were Sindhia, the Nizam of Hyderabad & the Begum of Bhopal.

LEADERS OF REVOLT OF 1857 IN INDIA

Mangal Pandey--Mangal Pandey joined the sepoy force of the British East India Company in the year 1849 at the age of 22. Pandey was part of the 34th Bengal Native Infantry & is primarily known for his involvement in an attack on his senior British officers on 29th March 1857 at Barrackpore. This incident marked an opening stage ofSepoy Mutiny of 1857 or the First War of Indian Independence.

Nana Sahib--At Kanpur, the revolt was led by Nana Sahib, the adopted son of exiled Maratha Peshwa Baji Rao II.

Rani Lakshmibai-Rani Lakshmibai (Manikarnika) was married to Raja Gangadhar Rao Newalkar, the Maharaja of Jhansi in 1842, & became the queen of Jhansi. After their marriage, She gave birth to a son Damodar Rao in 1851.

Tatya Tope--Tatya Tope was Nana Sahib's close associate & general. During the Siege of Cawnpore in 1857, Nana Sahib's forces attacked the British entrenchment at Kanpur in June 1857.

Veer Kunwar Singh--Veer Kunwar Singh, the king of Jagdispur, currently a part of Bhojpur district, Bihar, was one of the leaders of the Indian revolt of 1857.

Shah Mal--Shah Mal lived in a large village in pargana Barout in Uttar Pradesh. He mobilised the headmen & cultivators of chaurasee des, moving at night from village to village, urging people to rebel against the British.

Maulvi Ahmadullah Shah--Maulvi Ahmadullah Shah was one of the many maulvis who played an important part in the revolt of 1857. Educated in Hyderabad, he became a preacher when young. In 1856, he was seen moving from village to village preaching jehad (religious war) against the British & urging people to rebel. When he reached Lucknow in 1856, he was stopped by the police from preaching in the city. Subsequently, in 1857, he was jailed in Faizabad.

Delhi-Mughal Emperor, Bahadur Shah, but real command lay with Bakht Khan (was from the Barreily unit of the army).
Kanpur-Nana Sahib (from Kanpur, along with Tantia Tope & Azimullah)
Lucknow-Begum Hazrat Mahal of Awadh (declared her son as the Nawab of Awadh).
Bareilly--Khan Bahadur
Bihar (Arrah)--Kunwar Singh, Zamindar of Jagdishpur.
Jhansi - Rani LakshmI Bai
Allahabad - Liaquat ali

Important Governor Generals of India

Robert Clive (1757-60 & 1765-67):-

1. Governor of Bengal during this period.
2. Started dual Government in India in 1765.
3. He was a British officer who established the military & political supremacy of the East India Company in Bengal.
4. The foundations of the British empire in India were, it is said, laid by Robert Clive, known to his admirers as the "conqueror of India".
5. Clive defeated the Nawab of Bengal Shiraj-ud-daula in the famous Battle of Plassey in 1757.
6. Clive first arrived in India in 1743 as a civil servant of the East India Company; he later transferred to the military service of the Company & returned to England in 1753.
7. On 22 November 1774 Clive committed suicide, aged forty-nine, at his Berkeley Square home in London.

Warren Hastings (1772-74)

1. Abolished Dual Government started by Robert Clive in 1765.
2. Introduced quintessential settlement of land revenue in 1772.
3. Foundation of Asiatic Society of Bengal with the help of William Jones in 1784.
4. After his return to England in 1785, Impeachment proceeding were initiated against him in the house of Lord.
5. The first Governor-General of Bengal was Warren Hastings.
6. Rohila War in 1774, First Anglo-Maratha War (1776-82) & Second Anglo-Maratha War from 1780-84.

Lord Cornwallis (1786-93)

1. First Person to codify Laws in 1793. The code separated the revenue administration from the administration of Justice. Created the post of District Judge.
2. Introduced the Permanent settlement in 1793.
3. Cornwallis called "Father of Civil Service in India".
4. He also led the British forces in the third Anglo-Mysore war & defeated the Great Tipu Sultan, ruler of Mysore.
5. In 1793, He returned to England to receive the title of the Marques. & was granted seat in the Privy Council & died in 1805.

Lord Wellesley (1793-1798)

1. Described himself as "**Bengal Tiger**"
2. Introduced the system of Subsidiary Alliance.
3. Madras Presidency was formed during his period.
4. Signed the Treaty of Bassien & fought Second Anglo-Maratha war.

Lord Hastings (1813-1823)

1. Introduction of Ryotwari settlement in Madras Presidency by Governor Thomas Munro in 1820.
2. Adopted the Policy of intervention & War.
3. Mahalwari (Village Community) system of Land Revenue was made in North West Province by James Thomson.

Lord William Bentick (1828-1835)

1. First Governor General of India by Government of India Act 1833.
2. Most Liberal & Enlightened Governor General of India & regarded as the "Father of Modern Western Education in India".
3. Banned practiced of Sati in 1829. & banned female infanticide.
4. He made the English the court Language in higher court but Persian continued in Lower court.
5. Abolished Court of Appeals & Circuit set up by the Cornwallis.
6. Sir Charles Metcalfe (1835-36) called Liberator of Press.

Lord Dalhousie (1849-1856)

1. Lord Dalhousie introduced the Policy of Doctrine of Lapse captured Satara in 1848, Jaitpur & Sambhalpur in 1849. Baghat in 1850, Udaipur in 1852, Jhansi in 1853, & Nagpur in 1854.
2. Introduced Wood's Dispatch known as Magna Carta of English Education in India prepared by Charles Wood. It suggested a scheme of education from Primary to University level.
3. He laid the first Railway Line in 1853 from Bombay to Thane & second from Calcutta to Raniganj.
4. Gave a great impetus to Post & Telegraph. Telegraph lines were first laid from Calcutta to Agra.
5. Hindu Marriage Act passed in 1856.
6. A Post office Act was passed in 1854. Postage stamp were issued for the first time.
7. He was the youngest Governor General of India. He assumed charge at age of 36.
8. An Engineering Collage at Roorkee was established.
9. A separate Public Works Department was setup for the first time, Started work on Grand Trunk Road & developed the Harbours at Karachi, Bombay, & Calcutta.

Lord Canning (1856-62)

He was the first last Governor General of India & First Viceroy of India.

1. Revolt of 1857.
2. Queen Victoria's Proclamation & passing the Indian council act of 1858.
3. Doctrine of Lapse which was started by Lord Dalhousie was withdrawn in 1859.
4. Foundation of the Universities in Calcutta, Bombay, & Madras in 1857.
5. Indigo Revolt in Bengal in 1859-60.
6. Bahadur Shah was sent to Rangoon.
7. IPC & Cr.PC was enacted.
8. Income Tax was introduced for the first time in 1858.
9. Indian High Court act 1861 was enacted.

MODERN HISTORY AFTER 1885

The Indian National Congress

- Formed in 1885 by A.O.Hume, an Englishman & a retired civil servant.
- First session in Bombay under W.C.Banerjee in 1885 (72 delegates attended it).
- In the first two decades (1885 – 1905), quite moderate in its approach.
- But the repressive measures of the British gave rise to extremists within Congress like Bipin Chandra Pal, Bal Gangadhar Tilak & Lala Lajpat Rai (Lal, Bal, Pal).

Partition of Bengal:

- By Lord Curzon on Oct 16, 1905, through a royal Proclamation, reducing the old province of Bengal in size by creating East Bengal & Assam out of rest of Bengal.
- The objective was to set up a communal gulf between Hindus & Muslims.

Swadeshi Movement (1905):

- Lal, Bal, Pal, & Aurobindo Ghosh played the important role.
- INC took the Swadeshi call first at the Banaras Session, 1905 presided over by G.K.Gokhale. Bonfires of foreign goods were conducted at various places.

Formation of Muslim League (1906)

In December, 1906, All India Muslim League was set up under the leadership of Aga Khan, Nawab Salimullah of Dacca & Nawab Mohsin-ul-Mulk at Dacca. The League supported the partition of Bengal, opposed the Swadeshi movement & demanded special safeguards for its community & a separate electorate of Muslims.

Calcutta Session of INC (1906)

In Dec. 1906 at Calcutta, the INC under the leadership of Dada Bhai Naoroji adopted 'Swaraj' as the goal of Indian people. Naoroji in his presidential address declared that the goal of the INC was 'self government of Swaraj like that of United Kingdom'.

Surat Split (1907)

The INC split into the two groups i.e. the extremists & the moderates at the Surat session in 1907. The extremists were led by Tilak, Lajpat Rai & Bipin Chandra Pal while the moderates were led by G.K. Gokhale.

Alipore Bomb Case 1908

In 1908 a revolutionary conspiracy was intrigued to kill the Chief Presidency Magistrate D.H. Kingford of Muzaffarpur. The task was entrusted to Khudiram Bose & Prafulla Chaki. They threw the bombs on a vehicle coming out of the magistrate's home on April 30, 1908.

Morley-Minto Reforms (1909)

Morley-Minto Reforms were introduced in 1909 during the period when Lord Minto was the Viceroy of India while Morley was the secretary of the state. The reforms laid the foundation of institutionalized communalism as per the policy of divide & rule by introducing the separate electorates for Muslims. As per the provisions of the reform Muslims could only vote for Muslim candidates.

Arrival of Lord Hardinge 1910

From 1910 to 1916, Lord Hardinge served as India's Viceroy. The important event during his tenure was the Delhi Durbar of 1911.

Delhi Durbar of 1911

In 1910, there was a succession in England where King George V ascended the throne. In 1911 he paid a visit to India. Darbar was held to commemorate the coronation of King George V & Queen Mary as Emperor & Empress of India. In this Darbar, the King declared that Capital of India will be transferred from Calcutta to Delhi. In the same Darbar it was also declared the Partition of Bengal is cancelled.

Delhi conspiracy case 1912

It is said that the Delhi Conspiracy was hatched by Ras Bihari Bose, but was never proved. On 23 December 1912, a Bomb was thrown at the Viceroy Lord Hardinge when his procession was moving from Chandni Chowk. The Viceroy wounded in the attempt, but his Mahavat (driver & keeper of an elephant) was killed.

Ghadar Party (1913):

- Formed by Lala Hardayal, Taraknath Das & Sohan Singh Bhakna. HQ was at San Francisco.

Home Rule Movement (1915-16)

B.G Tilak was released from the Mandlay jail in the year 1914. In 1915 he reentered INC. B.G. Tilak founded Indian Home Rule League at Pune on 28 April, 1916. Annie Besant, inspired by the Irish rebellion, started Home Rule Movement in India in Sep., 1916. She started two newspapers i.e. Young India & Commonwealth. The leagues advocated passive resistance & civil disobedience.

Arrival of Lord Chelmsford 1916

On April 4, 1916, Lord Chelmsford took over as next Viceroy of India.

Lucknow Pact-Congress-League Pact (1916)

An important step forward in achieving Hindu- Muslim unity was the Lucknow Pact (1916). Anti- British feelings were generated among the Muslims following a war between Britain & Turkey which opened way for Congress & Muslim League unity. Both the Congress & the Muslim League held session at Lucknow in 1916 & concluded the famous Lucknow pact. The congress accepted the separate electorate & both organizations jointly demanded 'dominion status' for the country.

Montagu Declaration (August Declaration of 1917)

Montague made the landmark statement in the context of self rule in India in 1917. He said that the control over the Indian government would be transferred gradually to the Indian people. This was the result of Hindu-Muslim unity exhibited in Lucknow pact.

The Champaran Satyagraha of 1917 was Mahatma Gandhi's first Satyagraha. Champaran & Kheda Satyagraha were the events which later put Gandhi on the front seat of Indian National Revolution & made Satyagraha a powerful tool.

Kheda Satyagraha 1918

In 1918, Gujarat as a whole suffered a severe epidemic of Plague & in Kheda alone around 17000 people lost their lives. Further, cholera also broke out locally. This was the immediate reason of the revolt. The revolt was against the taxes. The government said that if the taxes are not paid, the property would be seized. This revolt gave India a robust leader in Sardar Vallabhbhai Patel. Sardar Vallabhbhai Patel & his colleagues organized this major tax revolt, which was able to mobilize all the castes & creeds of the region.

Rowlatt Act (March 18, 1919)

- This gave unbridled powers to the govt. to arrest & imprison suspects without trial for two years maximum.

Jallianwala Bagh Massacre (April 13, 1919):

- People were agitated over the arrest of Dr. Kitchlu & Dr. Satyapal on April 9, 1919. General O' Dyer fires at people who assembled in the Jallianwala Bagh, Amritsar on 13th April 1919.
- As a result hundreds of men, women & children were killed & thousands injured.
- Rabindranath Tagore returned his Knighthood (title) in protest.
- Sir Shankaran Nair resigned from Viceroy's Executive Council after this.
- Hunter Commission was appointed to enquire into it.
- On March 13, 1940, Sardar Udham Singh killed O'Dyer when the later was addressing a meeting in Caxton Hall, London.

Hunter Committee Report

The Jallianwala Bagh massacre was followed by establishment of a non-official enquiry committee the Government established a committee headed by Lord Hunter a Senator of the "College of justice of Scotland".

Khilafat Movement (1919-20):

- Muslims were agitated by the treatment done with Turkey by the British in the treaty that followed the First World War.
- Two brothers, Mohd.Ali & Shaukat Ali started this movement.

Non cooperation movement (1920-22)

The Non cooperation was the first mass movement launched under the leadership of Gandhi.

The program of non-cooperation included:

1. Surrender of titles
2. Boycott of government affiliated educational institutions
3. Boycott of courts of law
4. Boycott of foreign cloth
5. Nonpayment of taxes

Chaura Chouri incidence (1922)

On 5th February 1922, the Non Cooperation Movement was called off by Gandhi because of an unfortunate incidence at Chauri Chaura in Gorakhpur district of Uttar Pradesh. In this incidence the crowd participating in the Non Cooperation & Khilafat procession indulged into the violence with the police. As a result the crowd burnt a Police station & in the incidence 22 policemen were killed.

The Sawraj party (1922)

During this time a new political strategy; to carry forward the struggle against the colonial rule; was advocated by C.R. Das & Motilal Nehru. C.R. Das & Motilal Nehru put forward the changed strategy in Gaya session (1922) of the Congress. There were leaders in Congress like Vallabhbhai Patel, Rajendra Prasad & C.Rajgopalacharya who opposed these changes of council entry. C.R. Das & Motilal Nehru resigned from the Congress & formed the Swaraj Party.

Simon Commission (1927):

- Constituted under John Simon, to review the political situation in India & to introduce further reforms & extension of parliamentary democracy.
- Indian leaders opposed the commission, as there were no Indians in it.
- At Lahore, Lala Lajpat Rai was severely beaten in a lathi-charge. He died in 1928.

Nehru's Report (1928)

Lord Birkenhead, the Conservative Secretary of the State challenged Indians that they were not capable to formulate a concrete scheme of the constitutional reforms which had the support of wide section of political parties. He was of the view that a scheme of constitutional reform made by one political party in India would be opposed by the others & Indian political parties lacked the capabilities to form a consensus. To meet this challenge All Parties Conferences were held in 1928. A scheme was finalized which is popularly called "Nehru Report" as Motilal Nehru was its chief architect.

14 Points of Jinnah (March 9, 1929)

Jinnah, the leader of Muslim League, did not accept the Nehru Report. Jinnah thereafter drew up a list of demands, which was called '14 points of Jinnah'.

Lahore Session (1929)

At its annual session held in Lahore in Dec. 1929, under the presidentship of Jawaharlal Nehru, the Indian National Congress passed a resolution declaring 'Poorna Swaraj' (Complete Independence) to be the goal of the national movement. On Dec. 31, 1929, the newly adopted tricolor flag was unfurled & Jan 26 fixed as the Independence Day which was to be celebrated every year, pleading to the people not to submit to British rule any longer.

Civil Disobedience Movement

Phase "I" of Civil Disobedience Movement

In 1929 at Lahore Session, Congress made the "Purna Swaraj" or the complete independence as the aim of the Congress. On 31st January 1930, Gandhi gave his ultimatum to Lord Irwin with his 11 point demand. The Gandhi asked Irwin either to accept the 11 point demands else the Congress will launch Civil Disobedience. The demands were ignored by the British government. Thus Gandhi launched the Civil Disobedience

Movement with the Dandi march. It was from Sabarmati to Dandi. Gandhiji along with his 78 followers broke the Salt Act.

First Round Table conference (1930):

- It was the first conference arranged between the British & Indians as equals. It was held on Nov.12, 1930 in London to discuss Simon commission.
- Boycotted by INC, Muslim League, Hindu Mahasabha, Liberals & some others were there.

Gandhi Irwin Pact (1931):

- The two (government represented by Irwin & INC by Gandhiji) signed a pact on March 5, 1931. In this the INC called off the civil disobedience movement & agreed to join the second round table conference
- The government on its part released the political prisoners & conceded the right to make salt for consumption for villages along the coast.

Second Round Table Conference(1931):

- Gandhiji represented the INC & went to London to meet British P.M. Ramsay Macdonald. However, the session was soon deadlocked on the minorities issue & this time separate electorates was demanded not only by Muslims but also by Depressed Classes, Indian Christians & Anglo – Indians.

Phase "II" of CDM

After the failure of Second Round Table Conference, the working committee of the Congress resumed Civil Disobedience in.

The Communal Award (Aug 16,1932):

- Announced by Ramsay McDonald. It showed divide & rule policy of the British.
- Envisaged representation of Muslims, Sikhs, Indian Christians, Anglo Indians, women & even Backward classes.
- Gandhiji, who was in Yeravada jail at that time, started a fast unto death against it. Poona Pact (September 25, 1932):
- After the announcement of communal award & subsequent fast of Gandhiji, mass meeting took place almost everywhere.
- Political leaders like Madan Mohan Malviya, B.R.Ambedkar & M.C.Rajah became active.
- Eventually Poona pact was reached & Gandhiji broke his fact on the sixth day (Sept 25, 1932). In this, the idea of separate electorate for the depressed classes was abandoned, but seats reserved to them in the provincial legislature were increased.

Third Round Table Conference (1932):

- Proved fruitless as most of the national leaders were in prison. The discussions led to the passing of the Government of India Act, 1935.

The Government of India Act, 1935

The Simon Commission report submitted in 1930 formed the basis for the Government of India Act, 1935. The new Government of India Act received the royal assent on Aug. 4, 1935. The continued & extended all the existing features of earlier constitutional reforms. But in addition there were certain new principle introduced. It provided for a federal type of government. Thus, the act:

1. Introduced provincial autonomy.
2. Abolished dyarchy in provinces

Pakistan Resolution/Lahore Resolution (March 24, 1940)

It was 1930 that Iqbal suggested the union of the Frontier Province, Baluchistan, Sindh & Kashmir as Muslim state within the federations. The idealist Chaudhry Rehmat Ali developed this conception at Cambridge, where he inspired a group of young Muslims & invented the term 'Pakstan' (later 'Pakistan') in 1935. The ideology of Iqbal, the vision of Rehamat Ali, & the fears of Muslims were thus united by the practical genius of Jinnah to blind Muslim together.The Lahore session of the Muslim League, held on March 24, 1940, passed Pakistan Resolution & rejected the **Federal scheme** an envisaged in the government of India Act, 1935.

The August Offer (1940)

In order to win the public opinion in India, Linlithgow put up an offer to get the support of the nationalist in the World War "II".

Main Features-

- A promise of Dominion Status in an unspecified future
- A post war body to be created to enact a constitution, however this was to happen only after the approval from the British Parliament
- Immediate expansion in the Viceroy's executive council.
- Formation of a war advisory council.

Individual Satyagraha

The August offer shocked nationalists, & the Congress launched the individual Satyagraha. Vinobha Bhave was the first Satyagrahi while Nehru was second.

The Cripps Mission – 1942:

- In Dec. 1941, Japan entered the World War – II & advanced towards Indian borders. By March 7, 1942, Rangoon fell & Japan occupied the entire S E Asia.
- The British govt. with a view to getting cooperation from Indians sent Sir Stafford Cripps, leader of the House of Commons to settle terms with the Indian leaders.
- He offered a draft which proposed dominion status to be granted after the war
- Rejected by the Congress as it didn't want to rely upon future promises.
- Gandhiji termed it as a post dated cheque in a crashing bank.

Quit India Movement

The causes for the launch of Quit India Movement were:

- The failure of the Cripp's Mission was an eye opener for the nationalist.
- The news of Allied reverses in World War & British withdrawal from South-East Asia & Burma leaving local people at the mercy of Japanese.

Course of Events

- Quit India resolution was passed on 8th August 1942 at Bombay.
- The Congress envisaged a "mass struggle on the non-violent lines on the widest possible scale.

- It was made clear that if Congress leadership gets removed by arrest, "every Indian who desires freedom & strives for it must be his own guide".
- Gandhi & all the leaders of the Congress working committee were arrested on the early hours of August 9, 1942.
- There was a three month strike in Ahmedabad, the Stalinguard of India
- Usha Metha ran an illegal radio station
- Rajgopalacharya & Communists opposed the Quit India Movement
- The three parallel governments were formed at: 1. Ballia under Chittu Pandey 2. Tamkul- Jatia Sarkar of Satish Samant 3. Satara- Prati Sarkar under Nana Patil

Gandhiji's Fast (Feb. 10 – March 7, 1943)

Gandhiji undertook a 21-day fast in jail. His condition deteriorated after 13 days & all hopes of his surviving were given up.However, as a result his moral strength & spiritual stamina, he survived & completed the 21-day fast. This was his answer to the government which had been constantly exhorting him to condemn the violence of the people in the Quit India Movement.

C.R. Formula (1944)

In 1944, Chakravarti Rajagopalachari (C.R.) proposed to appoint a commission to separate the district in North-West & East where Muslims were in majority.In such areas, a voting to be held on the basis of adult suffrage to decide the issue of separation. They would be given freedom in case they favoured a sovereign state. In case of acceptance of partition, agreement to be made jointly for safeguarding defence, commerce,communications etc.

Muslim League was to endorse Congress demand for independence & cooperate in formation of provisional government. Jinnah objected, as he wanted Congress to accept two-nation theory & wanted only Muslims of the North-West & East of India to vote. Hindu Leaders led by V.D. Savarkar condemned the plan.

Wavell Plan & Shimla Conference (June 14 – July 14, 1945)

After consultations with the British Government on the Indian problem, Lord Wavell, the Viceroy of India, issued a statement known as Wavell Plan. The Plan, which chiefly concerned Viceroy's Executive Council, proposed certain changes in the structure of the council. One of the main proposals was that the Executive Council would be constituted giving a balanced representation to main communities in it, including equal representation to Muslims & Hindus. Soon after the Wavell Plan was issued the members of the Congress Working Committee were released from jails. A conference of 22 prominent Indian leaders called at Shimla to consider the Wavell Plan, reached no decision. What scutted the conference was Mr. Jinnah's unflinching stand that Muslim approved only by the Muslim League should be included in the Executive Council. Communalism thus again became a stumbling block. For the Britishers, however, the dissension between the Congress & the Muslim League was a source of happiness.

The Indian National Army:

- Founded by Rasbehari Bose with Captain Mohan Singh.
- S.C.Bose sretly escaped from India in 1941, & reached Berlin. In July 1943, he joined the INA at Singapore. There, Rasbehari Bose handed over the leadership to him.
- The soldiers were mostly raised from Indian soldiers of the British army who had been taken prisoners by the Japanese after they conquered S.E.Asia.
- Two INA head quarters were Rangoon & Singapore (formed in Singapore).
- INA had three fighting brigades named after Gandhiji, Azad & Nehru. Rani Jhansi Brigade was an exclusive women force.

INA Trials

- The first trial of INA prisoners took place at Red Fort.
- P.K. Seghal, Shah Nawaz & Gurbaksh Singh Dhillon were made accused.
- The counsels for defense were Bhulabhai Desai, Tej Bhadur Sapru, K.N. Kataju, J.L. Nehru & Asaf Ali
- Even though the Court Martial held the INA prisoners guilty, the Government felt it expedient to set them free.
- The question of guilt was not the issue, however it was Britain's right to decide the matter concerning Indians.

The revolt of Royal Indian Navy (RIN)

- In Feb. 1946, Bombay Ratings of HMIS Talwar revolted against British & struck work.
- The racial discrimination & bad food was the immediate cause of the revolt.
- B.C Dutta scrawled Quit India on the ships
- The HMIS Hindustan in Karachi also mutinied.
- By the end of February the strike had spread to naval bases all over the country involving about 20000 ratings.

The Cabinet Mission Plan (1946):

- The struggle for freedom entered a decisive phase in the year 1945-46. The new Labour Party PM.Lord Attlee, made a declaration on March 15, 1946, that British Cabinet Mission (comprising of Lord Pethick Lawrence as Chairman, Sir Stafford Cripps & A.V. Alexander) will visit India.
- The mission held talks with the INC & ML to bring about acceptance of their proposals.
- On May 16, 1946, the mission put towards its proposals. It rejected the demand for separate Pakistan & instead a federal union consisting of British India & the Princely States was suggested.
- Both Congress & Muslims League accepted it.

Direct Action Campaign (Aug, 16, 1946): Provoked by the success of the Congress (in the voting for Constituent Assembly), the Muslim League launched a 'direct action' campaign on Aug. 16, 1946, which resulted in heavy communal riots in the country.

Interim Government (Sept, 2, 1946):

On Sept. 2, 1946, an interim government was formed. Congress members led by Pt. Jawaharlal Nehru joined it but the Muslim League did not as it withdrew its earlier acceptance of the Cabinet Mission Plan.

Formation of Constituent Assembly (Dec. 9, 1946):

This Constituent Assembly met on Dec. 9, 1946, & Dr. Rajendra Prasad was elected its President. The Muslim League did not join the Assembly.

Attlee's Announcement (Feb. 20, 1947): On Feb. 20, 1947, British PM Attlee announced that the British would withdraw from India by June 30, 1948 & that Lord Mountbatten would replace Wavell.

Mountbatten Plan (June 3, 1947):

- On June 3, 1947, Lord Mountbatten put forward his plan which outlined the steps for the solution of India's political problem.
- The outlines of the Plan were:
- India to be divided into India & Pakistan.
- Bengal & Punjab will be partitioned & a referendum in NEFP & Sylhet district of Assam would be held.
- There would be a separate constitutional assembly for Pakistan to frame its constitution.
- The Princely states would enjoy the liberty to join either India or Pakistan or even remain independent.
- Aug.15, 1947 was the date fixed for handing over power to India & Pakistan.
- The British govt. passed the Indian Independence Act of 1947 in July 1947, which contained the major provisions put forward by the Mountbatten plan.

Partition & Independence (Aug 1947): All political parties accepted the Mountbatten plan.

- At the time of independence, there were 562 small & big Princely States in India.
- Sardar Vallabh Bhai Patel, the first home minister, used iron hand in this regard.

By August 15, 1947, all the States, with a few exceptions like Kashmir, Hyderabad & Junagarh had signed the Instrument of Accession.
Goa was with the Portuguese & Pondicherry with the French.

Revolutionary Activities:

- In 1908, Khudiram Bose & Prafulla chaki threw a bomb on the carriage of kingford, the unpopular judge of Muzaffapur. Khudiram, Kanhaiyalal Dutt & Satyendranath Bose were hanged. (Alipur Case)
- In 1912, Rasbihari Bose & Sachindra Nath Sanyal threw a bomb & Lord Hardinge at Delhi. (Delhi Conspiracy Case).
- In Oct, 1924, a meeting of revolutionaries from all parts of India was called at Kanpur. They setup Hindustan Republic Association.
- They carried out a dacoity on the Kakori bound train on the Saharanpur-Lucknow railway line on Aug. 9, 1925
- Bhagat Singh, with his colleagues, shot dead Saunders (Asst. S.P. of Lahore, who ordered lathi charge on Lala Lajpat Rai) on Dec.17, 1928
- Then Bhagat Singh & Batukeshwar Dutt threw a bomb in the Central Assembly on Apr 8, 1929. Thus, he, Rajguru & Sukhdev were hanged on March. 23,1931 at Lahore Jall (Lahore Conspiracy Case).
- In 1929 only Jatin Das died in Lahore jail after 63 days fast to protest against horrible conditions in jail.
- Surya Sen, a revolutionary of Bengal, formed the Indian Republic Army in Bengal. In 1930, he masterminded the raid on Chittagong armoury. He was hanged in 1933.
- In 1931, Chandrashekhar Azad shot himself at Alfred Park in Allahabad.

Important British Viceroys in India

Lord Canning (1856 – 1862) :

a. The last Governor General & the first Viceroy.
b. Mutiny(Revolt of 1857) took place in his time.
c. Withdrew Doctrine of Lapse (introduced by Lord Dalhousie).
d. The Universities of Calcutta, Bombay & Madras were established in 1857.
e. Indian Councils Act was passed in 1861.

Lord Lawrence (1864 – 1869) :

a) Telegraphic communication was opened with Europe.
b) High Courts were established at Calcutta, Bombay & Madras in 1865.
c) Expanded canal works & railways.
d) Created the Indian Forest department.

Lord Mayo (1869 – 1872) :

a) Started the process of financial decentralization in India.
b) Established the Rajkot college at Kathiarwar & Mayo College at Ajmer for the Indian princes.
c) For the first time in Indian history, a census was held in 1871.
d) Organised the Statistical Survey of India.
e) Was the only Viceroy to be murdered in office by a Pathan convict in the Andamans in 1872.

Lord Ripon (1880 – 1884) :

a) Repeated the Vernacular Press act (1882)
b) Passed the local self government act (1882)
c) Took steps to improve primary & secondary education (on William Hunter Commission's recommendations).
d) I Factory act, 1881, aimed at prohibiting child labour.
e) Passed the libert Bill (1883) which enabled Indian district magistrates to try European criminals.

Lord Dufferin (1884 – 1888) : Indian National Congress was formed during his tenure.

Lord Lansdowne (1888 – 1894) :

a) II Factory act (1891) passed during his time.
b) Categorization of Civil Services into Imperial, Provincial & Subordinate.
c) Indian Council act of 1892 was passed.
d) Appointment of Durand Commission to define the line between British India & Afghanistan.

Lord Elgin II (1894 – 1899) : Great famine of 1896 – 1897. Lyall Commission was appointed.

Lord Curzon (1899 – 1905) :

a) Passed the Indian Universities act (1904) in which official control over the Universities was increased.
b) Partitioned Bengal (October 16, 1905) into two provinces Bengal (proper) & East Bengal & Assam.
c) Appointed a Police Commission under Sir Andrew Frazer to enquire into the police administration of every province.
d) The risings of the frontier tribes in 1897 – 98 led him to create the North Western Frontier Province (NWFP).
e) Passed the Ancient Monuments Protection act (1904), to restore India's cultural heritage. Thus the Archaeological Survey of India was established.
f) Passed the Indian Coinage & Paper Currency act (1899) & put India on a gold standard.

Lord Minto (1905 – 1910) :

There was great political unrest in India. Various acts were passed to curb the revolutionary activities. Extremists like Lala Laipat Rai & Ajit Singh (in May, 1907) & Bal Gangadhar Tilak (in July, 1908) were sent to Mandalay jail in Burma. The Indian Council act of 1909 or the Morley Minto Reforms was passed.

Lord Hardinge (1910 – 1916) :

a) Held a durbar in December, 1911 to celebrate the coronation of King George V.
b) Partition of Bengal was cancelled (1911),
c) Capital shifted from Calcutta to Delhi (1912).
a) A bomb was thrown at him; but he escaped unhurt (December 23, 1912).
d) Gandhiji came back to India from South Africa (1915).
e) Annie Besant announced the Home Rule Movement.

Lord Chelmsford (1916 – 1921) :

a) August Declaration of 1917, whereby control over the Indian government would be gradually transferred to the Indian people.
b) The government of India act in 1919 (Montague Chelmsford reforms) was passed.
c) Rowlatt act of 1919; Jallianwala Bagh Massacre (April 13, 1919).
d) Non Cooperation Movement.
e) An Indian Sir S.P.Sinha was appointed the Governor of Bengal.
f) A Women's university was founded at Poona in 1916.
g) Saddler Commission was appointed in 1917 to envisage new educational policy.

Lord Reading (1921 – 1926) :

a) Rowlatt act was repeated along with the Press act of 1910.
b) Prince of Wales visited India in November, 1921.
c) Formation of Swaraj Party.
d) Vishwabharati University started functioning in 1922.
e) Communist part was founded in 1921 by M.N. Roy.
f) Kakory Train Robbery on August 9, 1925.
g) Communal riots of 1923 – 25 in Multan, Amritsar, Delhi, etc. Swami Shraddhanand, a great nationalist & a leader of the Arya Samajists, was murdered in communal orgy.

Lord Irwin (1926 – 1931) :

a) Simon Commission visited India in 1928.
b) Congress passed the Indian Resolution in 1929.
c) Dandi March (March 12, 1930).
d) Civil Disobedience Movement (1930).
e) First Round Table Conference held in England in 1930.
f) Gandhi Irwin Pact (March 5, 1931) was signed & g) Civil Disobediance Movement was withdrawn.
g) Martydorm of Jatin Das after 64 days hunger strike (1929).

Lord Willingdon (1931 – 1936) :

a) Second Round Table conference in London in 1931.
b) On his return Gandhiji was again arrested & Civil Disobedience Movement was resumed in January, 1932.
c) Communal Awards (August 16, 1932) assigned seats to different religious communities. Gandhiji went on a epic fast in protest against this division.
d) Third Round Table conference in 1932.
e) Poona Pact was signed.
f) Government of India act (1935) was passed.

Lord Linlithgow (1936 – 1944) :

a) Government of India act enforced in the provinces.
b) Congress ministries formed in 8 out of 11 provinces.
c) Churchill became the British PM in May, 1940. He declared that the Atlantic Charter (issued jointly by the UK & US, stating to give sovereign rights to those who have been forcibly deprived of them) does not apply to India.
d) Outbreak of World War II in 1939.

Lord Wavell (1944 – 1947) :

a) Arranged the Shimla Conference on June 25, 1945 with Indian National Congress & Muslim League; failed.
b) Cabinet Mission Plan (May 16, 1946).
c) Elections to the constituent assembly were held & an Interim Government was appointed under Nehru.
d) First meeting of the constituent assembly was held on December 9, 1946.

Lord Mountbatten (March 1947 – August 1947) :

a) Last Viceroy of British India & the first Governor General of free India.
b) Partition of India decided by the June 3 Plan.
c) Indian Independence Act,1947 passed by the British parliament on July 4, 1947, by which India became independent on August 15, 1947.
d) Retried in June 1948 & was succeeded by C. Rajagopalachari (the first & the last Indian Governor General of free India).

CONSTITUTIONAL DEVELPOMENTS BY THE BRITISH

Important Acts

The Regulating Act, 1773

- First attempt by the British Parliament to regulate the affairs of the Company.
- End of Dual Government.
- Provided for centralization of Administration of Company's territories in India.
- Governor of Bengal became Governor-general for all British territories in India.
- Governor General & council of 4 members appointed for Bengal.

- Bombay & Madras Presidency subordinated to Bengal presidency.
- Supreme court to be set up at Calcutta.

The Pitts India Act, 1784

- This Act gave the British government the supreme control over Company's affairs & its administration in India.
- Established dual system of governance. Court of directors consisting of 24 members was appointed to look after commercial functions.
- Board of control consisting of 6 parliamentary Commissioners appointed to control civil, military & revenue affairs of India.
- Strength of Governor general-in council reduced to 3.
- Subordinated the Bombay & Madras presidency to Bengal in all questions of war, diplomacy & revenues.
- First effective substitution of Parliamentary Control over East India Company.

The Charter Act of 1833

- End of company's trade monopoly even in tea & with China.
- Company was asked to close its business at the earliest.
- Governor-General of Bengal to be Governor-General of India. (1st Governor-General of India-Lord William Bentinck).
- Govt. of Madras & Bombay deprived of legislative powers.
- A fourth member, law member added to council of Governor-General.
- Government Service was thrown open to the people of India.
- All laws made by Governor General-in-council henceforth to be known as Acts & not regulations.

The Charter Act of 1853

- Extended life of the Company for an unspecified period.
- First time separate legislative machinery consisting of 12 member legislative council was created.
- Law member was made a full member of the Executive Council of the Governor-General
- Recruitment to Civil Services was based on open annual competitive examination. (excluding Indians)

The Govt of India Act, 1858

- Rule of Company in India ended & that of the Crown began.
- System of double Government ended. Court of Directors & Board of Control abolished.
- Secretary of State (a member of the British Cabinet) for India was created. He was assisted by a 15-member council (Indian Council). He was to exercise the powers of the Crown.
- Secretary of State governed India through the Governor-General. Governor-General was to be called the Viceroy & was the direct representative of the Crown in India.
- A unitary & highly centralized administrative structure was created.

The Indian Council Act, 1861

- Policy of Association of Indians in legislation started.
- A fifth member who was to be a jurist, was added to the Viceroy's executive council.
- Viceroy could issue ordinances in case of emergency.
- For legislation, executive Council of Viceroy was enlarged by 6 to 12 members composed of half non-official members. Thus foundations of Indian legislature were laid down.
- Legislative powers of the Presidency Government deprived in 1833 were restored.

Indian Council Act, 1909 (Morley-Minto Act)

- Morley was the secretary of state, while Minto was the Indian Viceroy.
- Additional members in central legislative assembly were increased to 60
- Introduced for the first time indirect elections to the Legislative Councils.
- Separate electorates were introduced for the muslims.
- Non-official seats were to be filled in by elections. They were distributed as follows

a) By non-official members of the Provincial Legislative councils.
b) By landholders of 6 provinces
c) By Muslims of 5 provinces
d) Alternately by Muslim landholders of Up/Bengal Chambers of commerce of Calcutta & Bombay.

Muslim were to be elected by Separate electorates.

- Resoultions could be moved before the budget was taken in its final form.
- Supplementary questions could be asked.

The Govt. of India Act, 1919

- Popularly known as Montague(SoS)-Chelmsford(Viceroy) Reforms.
- The idea of "Responsible Government" was emphasised upon.
- Devolution Rules:
- Subjects of administration were divided into two categories- "Central" & "Provincial".
- Subjects of all India importance (like railways & finance) were brought under the category of Central, while matters relating to the administration of the provinces were classified as provincial.
- Dyarchy system introduced in the Provinces. The Provincial subjects of administration were to be divided into two categories "Transferred" & "Reserved" subjects.

- The transferred subjects were to be administered by the Governor with the aid of Ministers responsible to the Legislative Council. The Governor & his Executive Council were to administer the reserved subjects (Rail, Post, Telegraph, Finance, Law & Order, etc.) without any responsibility to the legislature.
- An office of the High commissioner of India was created in London.
- Indian legislature became "bicameral" for the first time.
- Communal representation extended to Sikhs.
- Secretary of State for India now to be paid from British revenue.

GOI Act. 1935:

- Sought to introduce a federation
- Provided for 3-fold division of legislative power, i.e. three lists - Federal, Provincial & Concurrent Lists.
- Residuary powers to be vested with Governor-General
- Diarchy was introduced at the Centre
- Autonomy replaced diarchy at provincial level
- Provided for establishment of a Federal Court

Indian Independence Act, 1947

- This Act did not lay down any provision for the administration of India.
- Partition of India & the establishment of two dominions of India & Pakistan.
- Constituent Assembly of each Dominion would have unlimited powers to frame & adopt any constitution.
- The rule of the crown over Indian states was terminated.
- The office of the Secretary of State for India was to be abolished.

SOCIAL REFORMS DURING MODERN PERIOD

Atmiya Sabha
- 1815-1828
- Calcutta
- Raja Ram Mohan Roy
- To make reforms in the Hindu society

Wahabi MoveMENT
- 1820-1828
- Rohilkhand
- Syed Ahmed of Rae Bareilly
- Popularized the teachings of Waliullah; stressed role of individual conscience in religion.

BRAHMO SAMAJ
- Raja Ram Mohan Roy, Keshab Chandra Sen, Debendranath Tagore
- Emphasized on human dignity, & criticized social evils as Sati
- 1828
- CALCUTTA

Young Bengal(1826-1832)
- Calcutta
- Henry Vivian Derozio.
- Opposed vices in the society; believed in truth, freedom, & reason; social reform

Dharma Sabha
- 1830-Calcutta-Radha Kanta Deva
- Founded to oppose Brahmo Samaj Movement &
- Opposed to liberal & radical reforms including Sati.

Kuka/ Namdhari Movement
- 1841-1871
- NWF ProVince & Ludhiana
- Bhai Balak Singh & Baba Ram Singh
- **Spread the true spirit of Sikhism** & opposed to all caste distinctions.

Prarthana Samaj
- **1867**
- **Bombay**
- **Dr. Atmaram Pandurang**
- Reforming Hindu religious thought & practice in the light of modern knowledge.

Indian Reform Association
- **1870**
- **Calcutta**
- **Keshab Chandra Sen**
- Create public opinion against child marriages & for legalizing the Brahmo form of (Civil) marriage.
- Promote the intellectual & social service.

Arya Samaj
- 1875
- Bombay
- Swami Dayananda Saraswati
- To reform Hindu religion in North India

Theosophical Society
- 1875
- New York
- Madam HP Blavatsky & Col. H.S Olcott
- Advocated the revival & strengthening of ancient religions.
- of Hinduism, Deccan Zoroastrianism & Buddhism.

Deccan Education Society
- 1884
- Pune
- M.G.Ranade
- To contribute to the cause of education & culture in Western India.

Seva Sadan
- 1885
- Bombay
- Behramji & M.Malabari
- Campaign against child marriages & enforced widowhood & care for socially exploited women.

Ramakrishna Mission
- 1887, Calcutta
- Swami Vivekananda
- To carry on humanitarian relief & social Work

Indian National Social Conference(The social reform cell of the Indian National Congress.)
- 1887
- Bombay
- M.G.Ranade & Raghunath Rao
- To focus attention on matters relating to social reforms. The social reform cell of the Indian National Congress.

Deva Samaj
- 1887
- Lahore
- Shiva Narain Agnihotri
- Ideas closer to Brahmo Samaj He asked his followers to follow social code of conduct & ethics, as not to accept bribe, do not indulge in gambling.

Bharat Dharma Mahamandala
- 1902
- Varanasi
- Pandit Madan Mohan Malaviya
- Organization of the orthodox Hindus, also known as Sanatandharmis, to counter the teachings of the Arya Samaj.

The Servants of India Society
- 1905
- Bombay
- Gopal Krishna Gokhale
- To work for social reforms, & train "national missionaries for the service of India"

Poona Seva Sadan
- 1909
- Pune
- G.K. Devadhar & Ramabai Ranade
- Establish institutions for the economic uplift & useful employment of women.

The Bharat Stri Mandal
- **1910**
- **Calcutta**
- **Saralabala Devi Choudharani**
- **First women's organization on all-India basis to further the cause of women's education.**

The Indian Women's Association
- 1917
- Madras
- Mrs Annie Besant
- Work for uplift of Indian women & ''to secure a larger a free & fuller life for them".

MUSLIM SOCIAL REFORMS/ORGANIZATION

Khudai Khidmatgar Movement
- 1929.
- NWFP.
- Khan Abdul Gaffar Khan.
- Upliftment of people of Frontier & prepare them for attainment of independence.

Deoband Movement
(A school of Islamic Theology at Deoband Saharanpur,UP)
- 1867
- Deoband
- Mohd. Qasim Nanautavi & Rashid Ahmad Gagohi
- Improve the spiritual & moral conditions of India Muslim.

Aligarh Movement
- 1875
- Aligarh
- Sir Syed Ahmad Khan
- Liberalization of Indian Islam & modernization of Indian Muslims through religious reinterpretation, social reform & modern education.

Ahamadiya Movement
- 1889-90
- Faridkot
- Mirza Ghulam Ahmad
- Universal religion of all humanity, opposed to Islamic orthodoxy & spread of western liberal education among Indian Muslims.

Lower Caste Movements

Satya Shodhak Samaj
- 1873
- Maharashtra
- Jyotiba Phule
- Opposed to untouchability, Brahmin domination, belief in social equality & uplift of the lower castes by educating them.

Aravippuram Movement
- 1888
- Aravippuram, Kerala
- Shri Narayan Guru
- Opposed to religious disabilities against lower castes, believed in social equality, attacked Brahmin domination & worked for the uplift of lower castes by educating them. Demanded free entry of the people of lower castes temples.

The Depressed Classes Mission
- 1906
- Bombay
- V.R.Shinde
- Launched by the Prarthana Samaj as an Independent association to organize education facilities for lower castes.

Bahujan Samaj
- 1910
- Satara,Maharashtra
- Mukundrao Patil
- Opposed to exploitation of the lower castes by the upper caste people. Brahmins, landlords, merchants & moneylenders

Depressed Classes Society
- 1924

- Bombay
- Dr.B.R Ambedkar
- To propagate the gospel of social equality among caste Hindus & untouchables. Demanded constitutional safeguards for the depressed classes.

Self-Respect Movement
- 1925
- Madras (Tamil Nadu)
- E.V.Ramaswami
- Anti-Brahmin & Hindu Orthodoxy radical movement, advocated, weddings without priests, forcible temple entry, total defiance of Hindu social laws.

Harijan Sevak Sangh
- 1932
- Pune
- Mahatma Gandhi
- Organization for removal of untouchability & social discriminations against untouchables & other lower castes. Provide medical, educational & technical facilities to untouchables.

Freedom Fighters

Lokmanya Tilak
1856-1920
Introduced the celebration of Ganesh Chaturthi & Shivaji festivals. Paticipated in Home Rule Movement in 1916. Called by Britishers as 'Biggest Traitor' & 'Father of Indian dissatisfaction'

Lala Lajpat Rai Sher-e-Punjab.
Was sent to Jail at Mandey on the charges of seditious activities.

Sri Aurobindo Ghosh
His development of National education & editing of Bande Mataram (started by
Bipin Chandra Pal) gave momentum to Bengal partition movement. Left Baroda to work in the National College in Calcutta.

Chandra Shekhar Azad
Involved in the assassination of Saunders (officer who ordered the Lathi Charge in which Lala Lajpat was killed), alongwith Bhagat Singh & Rajguru. He had chalked out a plan to blow up the train in which the Viceroy Lord Irwin was traveling. He was killed in a police encounter at Alfred Park in Allahabad.

Bhagat Singh In association with Chhabil Das & Yashpal he had founded the Punjab Naujavan Bharat Sabha.
Rani Gaidinliu Lead the Nagas in the revolt. Yadunaga was the other leader.

Subhas Chandra Bose
Passed the Civils in 1920 but preferred to serve the nationalist cause. He was elected the Mayor of Calcutta in 1923 but soon arrested & sent to Mandalay.
Elected President at the Haripura session of Congress in 1938. He left for Kabul along with his friend Bhagat Ram. From there he went to Germany & met Hitler. He was first addressed as Netaji in Germany.

Udham Singh
Whilst living in England in 1940, Singh shot dead Sir Michael O'Dwyer, former Governor General of the Punjab.

GEOGRAPHY CAPSULE

Earth Solar System

Earth solar system consists of :
• The Sun • The Planets
• Dwarf Planets & countless fragments of left – overs called asteroids, meteors, comets & satellites of the planets (Called small solar system Bodies).

Solar System Some Facts

- **Biggest Planet** : Jupiter
- **Smallest Planet** : Mercury
- **Nearest Planet to Sun** : Mercury
- **Farthest Planet from Sun** : Neptune
- **Nearest Planet to Earth** : Venus
- **Brightest Planet** : Venus
- **Brightest star after Sun** : Sirius
- **Planet with maximum satellites**: Jupiter
- **Coldest Planet** : Neptune
- **Hottest Planet** : Venus
- **Heaviest Planet** : Jupiter
- **Red Planet** : Mars
- **Biggest Satellite** : Gannymede
- **Smallest Satellite** : Deimos
- **Blue Planet:** Earth
- **Morning/Evening Star** : Venus
- **Earth's Twin** : Venus
- **Green Planet** : Neptune
- **Planet with a big red spot** : Jupiter
- **Lord of the Heavens** : Jupiter
- **Greatest Diurnal Temperature**: Mercury

Earth Latitude & Longitude

Earth Latitude
- Imaginary lines drawn parallel to the equator. Measured as an angle whose apex is at the centre of the earth.
- The equator represents 0° latitude, while the North Pole is 90° N & the South Pole 90° S
- 23½° N represents Tropic of Cancer while 23½° S represents Tropic of Capricorn.
- 66½° N represents Arctic Circle while 66½° S represents Antarctic Circle.
- There are total 181 latitudes including the equator. Each parallel of latitude is a circle, but they are not equal.
- The circle becomes smaller toward`s the poles. Equator is the 'Greatest Circle' that can be drawn on the earth's surface.
- The distance between any two parallels of latitude is always equal.

- 1 degree lat. = 111km.

Earth Longitude

- It is the angular distance measured from die centre of the earth. On the globe the lines of longitude are drawn as a series of semicircles that extend from the North Pole to the South Pole through the equator. They are also called meridians.
- The distance between any two meridians is not equal.
- At the equator, 1 degree = 111 km. At 30°N or S, it is 96.5 km. It goes on decreasing this way until it is zero at the poles.
- There are 360 meridians of longitude. The prime meridian is a longitude of 00, passing through the Royal Observatory at Greenwich near London.
- This meridian is taken by geographers to divide the earth into the eastern & the western hemispheres.
- Each meridian of longitude is a semi-circle. 180° meridian (International Date Line) lies exactly opposite to 0° meridian. Such points are called Antipodal Points.
- The earth is divided into 24 longitudinal zones, each being 15° or 1 hour apart in time (4 minutes / degree).

Longitude & Time

- Places that are on the same meridian have the same local (sun) time. Since the earth makes one complete revolution of 360° in 24 hours, it passes through 15° in one hour or 1° in 4 minutes.
- The earth rotates from west to east, hence places east of Greenwich see the sun earlier & gain time whereas places west of Greenwich see the sun later & lose time.
- India, whose longitudinal extent is approx. 30°, has adopted only one time zone, selecting the 82.5°E for the standard time which is 5 hours & 30 minutes ahead of GMT (Greenwich Mean Time).

International Date Line

- It is the 180° meridian running over the Pacific Ocean, deviating at Aleutian Islands, Fiji, Samoa & Gilbert Islands. It is a zig-zag line
- Travelers crossing the Date Line from west to east (i.e., from Japan to USA) repeat a day & travelers crossing it from east to west (i.e., from USA to Japan) lose a day.

Important Parallels of Latitude

1. The Tropic of Cancer : It is in the northern hemisphere at an angular distance of 23 1/2° (23°30'N) from the equator.
2. The Tropic of Capricorn : It is in the southern hemisphere at an angular distance of 23 1/2° (23°30'S) from the equator.
3. The Arctic Circle : It lies at a distance of 66 1/2° (66°30'N) north of the equator.
4. The Antarctic Circle : It lies at a distance of 66 1/2° (66°30'S) south of the equator. There are two solstices each year, called the Summer Solstice & the Winter Solstice.
Summer Solstice : The day of 21st June when the sun is vertically overhead at the Tropic of Cancer (23°30'N).
Winter Solstice : The day of 22nd December when the sun is vertically overhead at the Tropic of Capricorn (23°30'S).

Meridians of Longitude

The semi-circles running from pole to pole or from north to south are known as meridians of longitude & distance between them is measured in degrees of longitude. Greenwich Meridian or Prime Meridian with a value of 0° longitude serves as a common base for numbering meridians of longitude lying on either side of it — east as well as west. There are 360 meridians including Prime Meridian. Each degree of a longitude is divided into sixty equal parts, each part is called a minute. Each minute is again divided into sixty equal parts, each part being called a second.
Local Time : Local time of any place is 12 noon when the sun is exactly overhead. It will vary from the Greenwich time at the rate of four minutes for each degree of longitude.
Greenwich Mean Time : The time at 0° longitude is called Greenwich Mean Time. It is based on local time of the meridian passing through Greenwich near London.
Indian Standard Time : It is fixed on the mean of 82 1/2°E Meridian, a place near Allahabad. It is 5 1/2hours ahead of Greenwich Mean Time.

Facts about earth

• The Earth also called Blue Planet. It is the densest of all planets.
• **Earth Circumference**: 40,232 Kilometers.
• **Earth Area**: 510 million Square Kilometers
• **Average distance from sun:** 149 million Kilometers.
• **Earth Perihelion:** Nearest position of earth to sun. The earth reaches its perihelion on January 3 every year at a distance of about 147 million-Kilometers.
• **Aphelion:** Farthest position of earth from sun. The earth reaches its aphelion on July 4, when the earth is at a distance of 152 million Kilometers.
• The shape of the earth is oblate spheroid or oblate ellipsoid (i.e. almost spherical, flattened a little at the poles with a slight bulge at the centre).

Types of Earth Movements:
1. Rotation or daily movement.

2. Revolution or annual movement.

Earth Rotation

• Spins on its imaginary axis from west to east in 23 hrs, 56 min & 40.91 sec.
• Rotational velocity at equator is 1667 Kilometers/h & it decreases towards the poles, where it is zero.

Earth's rotation results in

i. Causation of days & nights;
ii. A difference of one hour between two meridians which are 15° apart;
iii. Change in the direction of wind & ocean currents; Rise & fall of tides everyday.
iv. The longest day in North Hemisphere is June 21, while shortest day is on 22 Dec (Vice-versa in S.Hemisphere).
• Days & nights are almost equal at the equator.

Earth Revolution

• It is earth's motion in elliptical orbit around the sun. Earth's average orbital velocity is 29.79 Kilometers/s.
• Takes 365 days, 5 hrs, 48 min & 45.51 sec. It results in one extra day every fourth year.

• Revolution of the earth results in

i. Change of seasons
ii. Variation in the lengths of days & nights at different times of the year
iii. Shifting of wind belts
iv. Determination of latitudes.

Earth Eclipses

Earth Lunar Eclipse

· When earth comes between sun & moon.
· Occurs only on a full moon day. However, it does not occur on every full moon day because the moon is so small & the plane of its orbit is tilted about 5° with respect to the plane of the earth's orbit. It is for this reason that eclipses do not occur every month.
· This light is red because the atmosphere scatters the other colors present in sunlight in greater amounts than it does red.

Earth Solar Eclipse

A **solar eclipse** is a type of eclipse that occurs when theMoon passes between the Sun & Earth, & the Moon fully or partially blocks ("occults") the Sun. This can happen only at new moon

INTERIOR STRUCTURE OF THE EARTH

The layering of Earth is categorized as Lithosphere, Asthenosphere, Upper mantle, Lower mantle, Outer core, & the Inner core.
The earth's interior has three different layers; they are
(i) the crust (ii) mantle & (iii) the core.

a) Earth's Crust:

All of the Earth's landforms (mountains, plains, & plateaus) are contained within it, along with the oceans, seas, lakes & rivers. There are two different types of crust: thin oceanic crust that underlies the ocean basins & thicker continental crust that underlies the continents. These two different types of crust are made up of different types of rock. The boundary between the crust & the mantle is Mohorovicic Discontinuity.

b) Earth's Mantle: It is the thick, dense rocky matter that surrounds the core with a radius of about 2885 km. The mantle covers the majority of the Earth's volume. This is basically composed of silicate rock rich in iron & magnesium. This layer is separated from the core by Gutenberg-Wiechert Discontinuity. The outer & the inner mantle are separated by another discontinuity named Repetti discontinuity.

c) Earth's Core: Earth's Core is thought to be composed mainly of an iron & nickel alloy. The core is earth's source of internal heat because it contains radioactive materials which release heat as they break down into more stable substances. The core is divided into two different zones. The outer core is a liquid because the temperatures there are adequate to melt the iron-nickel alloy. However, the inner core is a solid even though its temperature is higher than the outer core. Here, tremendous pressure, produced by the weight of the overlying rocks is strong enough to crowd the atoms tightly together & prevents changing it to the liquid state.

EARTHQUAKES

a) An earthquake is the sudden release of strain energy in the Earth's crust resulting in waves of shaking that radiate outwards from the earthquake source.
b) The point at the surface directly above the focus is called the earthquake epicentre.
c) When the earth moves in an earthquake, it can cause waves in the ocean, & if a wave grows large enough, it's called a "tsunami".
e) Earthquakes are measured with a seismometer. The magnitude of an earthquake, & the intensity of shaking, is measured on a numerical scale. On the scale, 3 or less is scarcely noticeable, & magnitude 7 (or more) causes damage over a wide area. The point of origin of earthquake is called Seismic focus. The point on the earth's surface vertically above the earth's surface is called Epicentre.
f) The passage of earthquake waves is recorded by Seismograph. The magnitude of waves is measured on Richter's scale. For measurement of the intensity of the earthquake (damage caused), the Modified Mercalli Intensity Scale is used.

Distribution of Earthquakes

a) Around the Pacific Ocean along a belt of volcanoes known as the Ring of Fire. 68 per cent of the volcanoes are experienced in this region.
b) From the middle of Asia (Himalayas, Caspian Sea) through the Mediterranean Sea to West Indies. 21 per cent earthquakes are experienced in the region.
c) Mid-Atlantic ridge belt which accounts for 11 percent of the earthquakes.

TYPES OF SEISMIC WAVES

There are two types of seismic waves, body wave & surface waves.
• Body waves travel through the interior of the Earth. They follow ray paths refracted by the varying density & stiffness of the Earth's interior which in turn, vary according to temperature, composition, & phase.

Body waves are divided as

P-WAVES (Primary Waves) are compression waves that are longitudinal in nature. These waves can travel through any type of material, & can travel at nearly twice the speed of S waves.

S-WAVES (Secondary Waves) are shear waves that are transverse in nature. These waves typically follow P waves during an earthquake & displace the ground perpendicular to the direction of propagation. S waves can travel only through solids, as fluids (liquids & gases) do not support shear stresses. S waves are slower than P waves, & speeds are typically around 60% of that of P waves in any given material.

• Surface waves are analogous to water waves & travel along the Earth's surface. They travel slower than body waves.

There are two types of surface waves:

Rayleigh waves, also called ground roll, are surface waves that travel as ripples with motions that are similar to those of waves on the surface of water.

Love waves are surface waves that cause circular shearing of the ground. They are named after A.E.H. Love, a British mathematician who created a mathematical model of the waves in 1911. They usually travel slightly faster than Rayleigh waves, about 90% of the S wave velocity, & have the largest amplitude.

The asthenosphere separates the strong, solid rock of the uppermost mantle & crust above from the remainder of the strong, solid mantle below. The combination of uppermost mantle & crust above the asthenosphere is called the lithosphere. The lithosphere is free to move (glide) over the weak asthenosphere. The tectonic plates are, in fact, lithospheric plates.

VOLCANOES

A volcano is generally a conical shaped hill or mountain built by accumulations of lava flows, & volcanic ash. About 95% of active volcanoes occur at the plate subduction zones & at the mid-oceanic ridges. Subduction is the process that takes place at convergent boundaries by which one tectonic plate moves under another tectonic plate & sinks into the mantle as the plates converge. Regions where this process occurs are known as sub-duction zones. The other 5% occur in areas associated with lithospheric hot spots. It is believed that hot spots are caused by plumes of rising magma that have their origin within the asthenosphere.

Types of Volcanoes

Geologists have classified five different types of volcanoes. This classification is based on the geomorphic form, magma chemistry, & the explosiveness of the eruption. The least explosive type of volcano is called a **basalt plateau.** These volcanoes produce a very fluid basaltic magma with horizontal flows. Deposits of these volcanoes can be as thick as 1800 meters. Large basalt plateaus are found in the Columbia River Plateau, western India, northern Australia, Iceland, Brazil, Argentina, & Antarctica. Some basaltic magmas can produce very large slightly sloping volcanoes, 6 to 12°, that have gently flowing magmas called shield volcanoes **Shield volcanoes** can be up to 9000 meters tall. The volcanoes of the Hawaiian Islands are typical of this type.

A cinder cone is a small volcano, between 100 & 400 meters tall, made up of exploded rock blasted out of a central vent at a high velocity. These volcanoes develop from magma of basaltic to intermediate composition. They form when large amounts of gas accumulate within rising magma. Examples of cider cones include Little Lake Volcano in California & Paricuti Volcano in Mexico.

Composite volcanoes are made from alternate layers of lava flows & exploded rock. Their height ranges from 100 to 3500 meters tall. The chemistry of the magma of these volcanoes is quite variable ranging from basalt to granite.

Magmas that are more granitic tend to be very explosive because of their relatively higher water content. Water at high temperatures & pressures is extremely volatile. Examples of composite volcanoes include Italy's Vesuvius, Japan's Mount Fuji, & Washington State's Mount Rainier & Mount St. Helens.

The most explosive type of volcano is the caldera.

Classification on the basis of Periodicity of Eruptions:

Active Volcano:

Volcanoes which erupt periodically. E.g. Maona Loa in Hawaii, Etna in Sicily, Vesuvius in Italy, Stromboli in Mediterranean Sea, etc.

Dormant Volcano:

Volcanoes which has been quiet for a long time but in which there is a possibility of eruption. E.g. Fujiyama in Japan, Krakatoa in Indonesia, Barren island Volcano in Andamans, etc.

Distribution of Volcanoes in the World

About 15% of world's active volcanoes are found along the 'constructive or divergent' plate margins, whereas 80% volcanoes are associated with the 'destructive or convergent' plate boundaries.

Earth Mountains

Types of Mountains

Fold Mountains of the World: They are formed when the rocks of the crust of the earth folded under stress, mainly by forces of compression (as a result of series of earthquakes). **E.g.** – All big Mountain Systems: Himalayas, Alps, Andes, Rockies, Atlas, etc.

Old Mountains

They belong to pre-drift era, then subjected to denudation & uplift; many faults were formed; occur as relict mountains today. E.g. Pennines (Europe), Appalachians (US), Aravallis (India).

Relict Mountains: Sometimes, the mountains are carved out as a result of erosion of plateaus & high planes by various agents of erosion. E.g., Highlands of Scotland, Sierras of Spain, Catskill mountains of New York & Nilgiri, Parasnath, Girnar, Rajmahal of India.

ROCKS & MINERALS

About 98 per cent of the total crust of the earth is composed of eight elements like oxygen, silicon, aluminium, iron, calcium, sodium, potassium & magnesium, & the rest is constituted by titanium, hydrogen, phosphorous, manganese, sulphur, carbon, nickel & other.

1) **The three types of rocks are**
a) Igneous rocks (formed directly from liquid rock),
b) Metamorphic rocks (formed by direct alteration of existing rocks), &
c) Sedimentary rocks (formed by eroded materials from other rocks).

a)Igneous Rocks

1) Igneous rocks solidify from a liquid magma as it cools. When magma cools rapidly, mineral crystals do not have time to grow very large. On the other hand when magma cools slowly crystals grow to several millimeters or more in size.
Granite & basalt are the examples of IR. Igneous rocks are classified as

a) Extrusive Rocks

Extrusive igneous rocks solidify from molten material that flows over the earth's surface (lava).
Common extrusive rocks are
i) basalt,
ii) andesite, &
iii) rhyolite.

b) Intrusive Rocks

Intrusive rocks form from molten material (magma) that flows & solidifies underground.
Common rock types within the intrusive category are granite & diorite.

ii. Sedimentary Rocks

These are types of rocks created from deposition of layers upon layers of sediments over time. These types of rocks are formed on the Earth's surface, as well as underwater.
Examples – Sandstone, limestone, stromatolites , oil shale & coal shale, gypsum, shale, & conglomerate.

iii. Metamorphic Rocks

Metamorphic rocks are any rock type that has been altered by heat, pressure, and/or the chemical action of fluids & gases. When igneous rocks, or sedimentary rocks, or even metamorphic rocks get buried very deep under the earth's surface, a process that takes millions of years, they get changed into something else by the enormous pressure & heat inside the earth.

"Some examples of metamorphic rocks are:

- Limestone being changed into marble
- Shale turning into slate
- Granite being changed into gneiss
- Sandstone turning into quartzite

ATMOSPHERE

Atmosphere is a thick gaseous envelope that surrounds the earth & extends thousands of kilometers above the earth's surface. Much of the life on the earth exists because of the atmosphere otherwise the earth would have been barren. Nitrogen & Oxygen comprise 99% of the total volume of the atmosphere.

Structure of the Atmosphere

The atmosphere consists of almost concentric layers of air with varying density & temperature.

a) Troposphere:

- Lowest layer of the atmosphere.
- The height of troposphere is 16 km thick over the equator & 10 km thick at the poles.
- All weather phenomena are confined to troposphere (e.g. fog, cloud, frost, rainfall, storms, etc.)
- Temperature decreases with height in this layer roughly at the rate of 6.5° per 1000 metres, which is called **normal lapse rate.**
- Upper limit of the troposphere is called **tropopause** which is about 1.5 km.
- **b) Stratosphere:**
- The stratosphere is more or less devoid of major weather phenomenon but there is circulation of feeble winds & cirrus cloud in the lower stratosphere.
- Jet aircrafts fly through the lower stratosphere because it provides perfect flying conditions.
- Ozone layer lies within the stratosphere mostly at the altitude of 15 to 35 km above earth's surface.
- Ozone layer acts as a protective cover as it absorbs ultra-voilet rays of solar radiation.
- Depletion of ozone may result in rise of temperature of ground surface & lower atmosphere.
- Temperature rises from -60°C at the base of the stratosphere to its upper boundary as it absorbs ultra-voilet rays.
- Upper limit of the Stratosphere is called **stratopause.**

c) Mesosphere

- Mesosphere extends to the height of 50-90 km.
- Temperature decreases with height. It reaches a minimum of -80°C at an altitude of 80-90 km
- The upper limit is called **mesopause**.

d) Thermosphere

- It lies at 80 km to 640 km above the earth's surface.
- It is also known as ionosphere.
- Temperature increases rapidly with increasing height.
- It is an electrically charged layer. This layer is produced due to interaction of solar radiation & the chemicals present, thus disappears with the sunset.
- There are a number of layers in thermosphere e.g. D-layer, E-layer, F-layer & G-layer.
- Radio waves transmitted from earth are reflected back to the earth by these layers.

e) Exosphere

- This is the uppermost layer of the atmosphere extending beyond the ionosphere.
- The density is very low & temperature becomes 5568°C.
- This layer merges with the outer space.

About Ionosphere

At heights of 80 km (50 miles), the gas is so thin that free electrons can exist for short periods of time before they are captured by a nearby positive ion. This portion of the atmosphere is ionized & contains plasma which is referred to as the ionosphere. The Ultraviolet (UV), X-Ray & shorter wavelengths of solar radiation ionizes the atmosphere. The ionosphere is broken down into the D, E & F regions.

PRESSURE & WIND BELTS

Air pressure is thus defined as total weight of a mass of column of air above per unit area at sea level. The amount of pressure exerted by air at a particular point is determined by temperature & density which is measured as a force per unit area.

- **Aneroid Barometer-**It is the most common type barometer used in homes.

Pressure Belts of the World

a) Equatorial Low Pressure Belt:
At the Equator heated air rises leaving a low-pressure area at the surface. This low pressure area is known as **equatorial low pressure.** The zone shifts along with the northward or southward movement of sun during summer solstice & winter solstice respectively. The pressure belt is thermally induced because the ground surface gets heated during the day. Thus warm air expands, rises up & creates low pressure.

b) Sub-tropical High Pressure Belt:
The warm air risen up at the equator due to heating reaches the troposphere & bend towards the pole. Due to coriolis force the air descends at 30-35º latitude thus creates the belt of **sub-tropical high pressure.** The pressure belt is dynamically induced as it owes its origin to the rotation of the earth & sinking & settling of winds. This zone is characterized by anticyclonic conditions which cause atmospheric stability & aridity.

c) Sub-Polar Low Pressure Belt:
This belt is located between 60-65 degrees latitudes in both the hemisphere. This pressure belt is also dynamically induced. The belt is more developed & regular in the southern hemisphere than the northern due to over dominance of water in the former.

d) Polar High Pressure Belt:
High pressure persists at the pole due to low temperature. Thus the Polar High Pressure Belt is thermally induced as well as dynamically induced as the rotation of earth also plays a minor role.

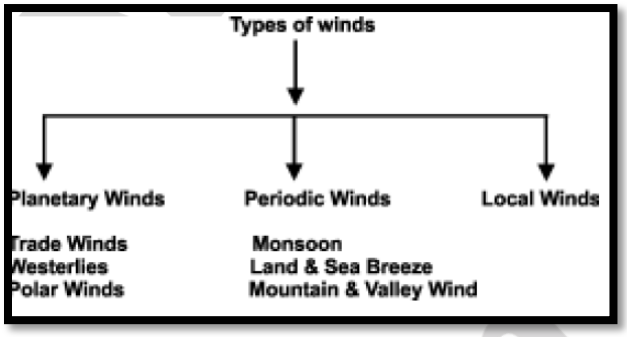
Coriolis Force

The rotation of the Earth creates force, termed Coriolis force, which acts upon wind. Instead of wind blowing directly from high to low pressure, the rotation of the Earth causes wind to be deflected off course. In the Northern Hemisphere, wind is deflected to the right of
its path, while in the Southern Hemisphere it is deflected to the left. Coriolis force is absent at the equator, & its strength increases as one approaches either pole. Furthermore, an increase in wind speed also results in a stronger Coriolis force, & thus in greater deflection of the wind.

Winds

When the movement of the air in the atmosphere is in a horizontal direction over the surface of the earth, it is known as the wind. Movement of the wind is directly controlled by pressure. Horizontally, at the Earth's surface wind always blows from areas of high pressure to areas of low pressure usually at speeds determined by the rate of air pressure change between pressure centres.

I. Planetary winds:



Planetary winds are major component of the general global circulation of air. These are known as planetary winds because of their prevalence in the global scale throughout the year. Planetary winds occur due to temperature & pressure variance throughout the world.

The planetary winds are discussed below:

(a) Trade wind
Winds blowing from the Subtropical High Pressure Belt or horse latitudes towards the Equatorial Low Pressure Belt or the ITCZ are the trade winds. In the Northern Hemisphere, the trade winds blow from the northeast & are known as the **Northeast Trade Winds**; in the Southern Hemisphere, the winds blow from the southeast & are called the **Southeast Trade Winds.**

(b) Westerly Wind
The Westerlies are the prevailing winds in the middle latitudes between 35º & 65º latitude, blowing from the high pressure area in the Sub Tropical High Pressure Belt i.e. horse latitudes towards the sub polar low pressure belt. The winds are predominantly from the south-west to north-east in the Northern Hemisphere & from the north-west to south-east in the Southern Hemisphere.
The Westerlies are strongest in the winter season & times when the pressure is lower over the poles, while they are weakest in the summer season & when pressures are higher over the poles. The Westerlies are particularly strong, especially in the Southern Hemisphere, as there is less land in the middle latitudes to obstruct the flow.

(c) Polar Wind
The winds blowing in the Arctic & the Antarctic latitudes are known as the Polar Winds. They have been termed the **'Polar Easterlies',** as they blow from the Polar High Pressure belt towards the Sub-Polar Low-Pressure Belts. In the Northern Hemisphere, they blow in general from the north-east, & are called the North-East Polar Winds; & in the Southern Hemisphere, they blow from the south-east & are called the South- East Polar Winds. As these winds blow from the ice-capped landmass, they are extremely cold.
They are more regular in the Southern Hemisphere than in the Northern Hemisphere.

II. Periodic Winds:
Land & sea breezes & monsoon winds are winds of a periodic type. Land & sea breezes occur daily, whereas the occurrence of monsoon winds is seasonal. Following are periodic winds:

(a) Monsoon winds
(b) Land & Sea Breeze

(c) Mountain & Valley Breeze

(a) Monsoon Winds
Monsoons are regional scale wind systems that predictably change direction with the passing of the seasons. Like land & sea breezes, these wind systems are created by the temperature contrasts that exist between the surfaces of land & ocean.

(b) Land & Sea Breezes:
A **land breeze** is created when the land is cooler than the water such as at night & the surface winds have to be very light. When this happens the air over the water slowly begins to rise, as the air begins to rise, the air over the surface of the ocean has to be replaced, this is done by drawing the air from the land over the water, thus creating a sea breeze.
A **sea breeze** is created when the surface of the land is heated sufficiently to start rising of the air. As air rises, it is replaced by air from the sea; you have now created a sea breeze. Sea breezes tend to be much stronger & can produce gusty winds as the sun can heat the land to very warm temperatures, thereby creating a significant temperature contrast to the water.

(c) Mountain & Valley winds:
Mountain-valley breezes are formed by the daily difference of the thermo effects between peaks & valleys. In daytime, the mountainside is directly heated by the sun, the temperature is higher, air expands, air pressure reduces, & therefore air will rise up the mountainside from the valley & generate a valley breeze.

III. Local Winds
These local winds blow in the various region of the world.

Hot Winds
Sirocco - Sahara Desert
Leveche - Spain
Khamsin - Egypt
Harmattan - Sahara Desert
Santa Ana - USA
Zonda - Argentina
Brick fielder - Australia

Cold Winds
Mistral - Spain & France
Bora - Adriatic coast
Pampero - Argentina
Buran - Siberia

JET-STREAMS

The JET STREAMS located in the upper troposphere (9 - 14 km) are bands of high speed winds (95-190 km/hr). The term was introduced in 1947 by Carl Gustaf Rossby. Average speed is very high with a lower limit of about 120 Kms in winter & 50 km per hours in summer. The two most important types of jet streams are the **Polar Jet Streams &** the **Subtropical Jet Streams.**

CYCLONES

Cyclones are well developed low-pressure systems surrounded by closed isobars having increasing pressure outside & closed air circulation towards the centre such that the air blows inward in anticlockwise direction in the northern hemisphere & clockwise in the southern hemisphere.

A. Tropical cyclones
Tropical cyclones are intense cyclonic storms that develop over the warm oceans of the tropics. Surface atmospheric pressure in the centre of tropical cyclones tends to be extremely low.
The main characteristics of tropical cyclones are:-
• Have winds that exceed 34 knots (39 miles/hr)
• Blow clockwise in the Southern Hemisphere and
• Counter-clockwise about their centres in the Northern Hemisphere
This is one of the most devastating natural calamities. They are known as Cyclones in the Indian Ocean, Hurricanes in the Atlantic, Typhoons in the Western Pacific & South China Sea, & Willy-Willies in the Western Australia.

B. Temperate cyclones
The systems developing in the mid & high latitude, beyond the tropics are called the middle latitude or temperate cyclones.
Extra tropical cyclones form along the polar front. Two air masses of contrasting physical properties: one air mass is polar in character & is cold, denser & north-easterly in direction while the other air mass is tropical in origin & is warm, moist, lighter & south westerly in direction.
An **anticyclone** is a region of high atmospheric pressure related to the surrounding air, generally thousands of kilometres in diameter & also known as a **high** or **high-pressure system.** Winds in an anticyclone form a clockwise out-spiral in the Northern Hemisphere; whereas they form an anti-clockwise out-spiral in the Southern Hemisphere.

OCEANOGRAPHY
The study of sea floor by echo method of sound waves reveals that the sea floor is not a flat area. It consists of mountains, plateaus, plains & trenches etc. Some major submarine features are described below.

a) Continental Shelf
1) The portion of the land which is submerged under sea water is continental shelf.
2) The continental shelf is shallow & its depth is not more than 200 metres.
3) In all about 7.5 percent of total area of the oceans is covered by the continental shelves.

The shelves are of great use to man because:
1. Marine food comes almost entirely from them.
2. About 20 percent of oil & gas of the world is extracted from them.
3. They are the sites of productive fishing grounds.

b) Continental Slope

It is an area of steep slope extending just after the continental shelf up to a considerable depth from where a gentle sea plain takes its form. The extent of the slope area is usually between 200-2000 m. But sometimes it may extend to 3660 metres from the mean sea level. The continental slope along many coasts of the world is followed by deep canyon like trenches terminating as fan shaped deposits at the base. Continental slope covers 8.5 percent of the total ocean area.

c) Continental Rise

1) The gently sloping surface at the base of the continental slope is called continental rise.
2) It may extend to hundreds of km into the deep ocean basin.

d) Deep Ocean Basins

It is the portion of sea floor that lies between the continental margin & the oceanic ridge system. It contains deep-ocean trenches, abyssal plains, & broad volcanic peaks called seamounts.

I. Deep-Ocean Trenches:

a) These are long, narrow features that form the deepest parts of the ocean.
b) Most trenches are located in the Pacific Ocean.
c) They may reach 10,000 m deep
d) (Mariana trench is 11,000 m below sea level in PO).

II. Abyssal Plains:

These are the most level places on Earth. The abyssal plains may have less than 3 m of relief over a distance that may exceed 1300 km. Scientists determined that abyssal plains low relief is due to the fact that thick accumulations of sediment, transported by turbidity currents, have buried rugged ocean floor.

III. Seamounts:

It is an isolated volcanic peak that rises at least 1000 m (3300 ft) above the deep-ocean floor.
They are more extensive in the Pacific Ocean, where subduction zones are common. These undersea volcanoes form near oceanic ridges (regions of seafloor spreading). Some of these volcanoes may emerge as an island.

e) Submarine Canyons

These are depressions with walls of steep slopes & have a V shape. They exist on the continental slopes & the shelves. They are found to have a length of 16 km at the maximum.

OCEAN CURRENTS

Ocean currents are large masses of surface water that circulate in regular patterns around the oceans. Those that flow from equatorial regions polewards have a higher surface temperature & are warm currents. Those that flow from polar regions equatorwards have a lower surface temperature & are cold currents.

Factors lead to OCEAN CURRENT

1. **The planetary winds**.
2. **Temperatures.**
3. **Salinity**.
4. **The earth's rotation.**
5. **Land**.

THE CIRCULATION (THE ATLANTIC OCEAN)

At the 'shoulder' of north-east Brazil, the protruding lands mass splits the South Equatorial Current into the Cayenne Current which flows along the **Guiana coast, & the Brazilian Current** which flows southwards along the east coast of Brazil. Part of the current enters the Gulf of Mexico & emerges from the Florida Strait between Florida & Cuba as the **Florida Current.** The rest of the equatorial water flows northwards east of the Antilles **to join the Gulf Stream off the south-eastern U.S.A.** The Gulf Stream Drift is one of the strongest ocean currents & hugs the coast of America as far as Cape Hatteras (latitude 35^0N), where it is deflected eastwards under the combined influence of the Westerlies & the rotation of the earth. It reaches Europe as the **North Atlantic Drift**.

The cold **Labrador Current** drift southeastwards between West Greenland & Baffin Island to meet the warm Gulf Stream off Newfoundland. On reaching the west coast of Africa the current is diverted northwards as **the cold Benguela Current** (the counterpart of the Canaries Current).

THE CIRUCLATION (PACIFIC OCEAN)

The North- East Trade Winds blow the **North Equatorial Current** off the coasts of the Philippines & Formosa into the East China Sea as the Kuroshio or Japan current. The cold **Bering Current or Alaskan Current** creeps southwards from the narrow Bering Strait & is joined by Okhotsk Current to meet the warm Japan Current as **the Oyashio**, off Hokkaido. The South Equatorial Current, driven by the South-East Trade winds, flows southwards along the coast of Queensland as the **East Australian Current**. Obstructed by the tip of southern Chile, the current turns northwards along the western coast of South America as the **cold Humboldt or Peruvian**

Current.

THE INDIAN OCEAN CIRCULATION

The currents of **South Indian Ocean** form a circuit. The Equatorial Current, turning southwards past Madagascar as the Agulhas or Mozambique Current merges with the West Wind Drift, flowing eastwards & turns equator-wards as the West Australian Current. In the North Indian Ocean, there is a complete reversal of the direction of currents between summer & winter, due to the changes of monsoon winds. In summer from June to October, when the dominant wind is the South-West Monsoon, the currents are blown from a south-westerly direction as the South- West Monsoon Drift. This is reversed in winter; Monsoon blows the currents from the north-east as the North-East Monsoon Drift. The currents of the North Indian Ocean, demonstrate most convincingly the dominant effects of winds on the circulation of ocean currents.

OCEANS

Arctic Ocean-- The Arctic Ocean is the smallest of the world's five oceans. The Northwest Passage (US & Canada) & Northern

Sea Route (Norway & Russia) are two important seasonal waterways.
It is a body of water between Europe, Asia, & North America, mostly north of the Arctic Circle.
Lowest point: Fram Basin

Atlantic Ocean-- The Atlantic Ocean is the second largest of the world's five oceans. The Kiel Canal (Germany), Oresund (Denmark-Sweden), Bosporus (Turkey), Strait of Gibraltar (Morocco-Spain), & the Saint Lawrence Seaway (Canada-US) are important strategic access waterways.
It is a body of water between Africa, Europe, the Southern Ocean, & the Western Hemisphere. **It includes** includes Baltic Sea, Black Sea, Caribbean Sea, part of the Drake Passage, Gulf of Mexico, Mediterranean Sea, & other tributary water bodies.
Lowest point: Milwaukee Deep in the Puerto Rico Trench

Indian Ocean
The Indian Ocean is the third largest of the world's five oceans. Four critically important access waterways are the Suez Canal (Egypt), Bab-el Mandeb (Djibouti-Yemen), Strait of Hormuz (Iran-Oman), & Strait of Malacca (Indonesia-Malaysia).
It is a body of water between Africa, the Southern Ocean, Asia, & Australia. It includes Andaman Sea, Arabian Sea, Bay of Bengal, Flores Sea, Gulf of Aden, Gulf of Oman, Java Sea, Red Sea, Strait of Malacca, Timor Sea, & other tributary water bodies.
Lowest point: Java Trench

Pacific Ocean
The Pacific Ocean is the largest of the world's five oceans. Strategically important access waterways include the La Perouse, Tsugaru, Tsushima, Taiwan, Singapore, & Torres Straits.
It is body of water between the Southern Ocean, Asia, Australia, & the Western Hemisphere. It includes Bali Sea, Bering Sea, Coral Sea, East China Sea, Gulf of Alaska, Philippine Sea, Sea of Japan, Sea of Okhotsk, Tasman Sea, & other tributary water bodies.
Lowest point: Challenger Deep in the Mariana Trench.

TIDES

The tide is the periodic rise & fall of the sea levels caused by the combined effects of the gravitational forces exerted by the Moon & Sun & rotation of the earth. Most places in the ocean usually experience two high tides & two low tides each day (semidiurnal tide), but some locations experience only one high & one low tide each day (diurnal tide). The times & amplitude of the tides at the coast are influenced by the alignment of the Sun & Moon, by the depth of the ocean, & by the shape of the coastline & near-shore bathymetry.
When the moon exerts gravitational force on the earth the tidal bulge moves out & causes high tide. Simultaneously on the side opposite to that place on the earth i.e. just at 180° to it, also experiences the tidal bulge due to reactionary force (centrifugal) of the gravitational (centripetal) force. Thus two tides are experienced twice at every place on the earth's water surface within 24 hours.
Due to the cyclic rotation of the earth & moon, the tidal cycle is 24 hours & 52 minutes long.

Causes of Tides

- Gravitational attraction between moon & the earth.
- Gravitational attraction between sun & the earth.
- Attraction force of the earth towards earth centre.
- Moon is mainly responsible for the tides.

Types of Tides

- Semi diurnal tides - Recur at the intervals of 12½ hours.
- Diurnal Tides - Recur at the intervals of 24½ hours.
- Spring Tides - once a fortnight, due to the revolution of the moon & its declination.
- Neap tides - Once a fortnight due to the revolution & declination of moon.
- Monthly tides - Due to the revolution of the moon & its position at Perigee & Apogee.

SPRING TIDES

Spring tides are especially strong tides or high tides. They occur when the Earth, the Sun, & the Moon are in a line. The gravitational forces of the Moon & the Sun both contribute to the tides. Spring tides occur during the full moon & the new moon.

NEAP TIDES

Neap tides are especially weak tides. They occur when the gravitational forces of the Moon & the Sun are perpendicular to one another (with respect to the Earth). Neap tides occur during quarter moons.
The Bay of Fundy between Nova Scotia & New Brunswick in Canada experiences the world's greatest tidal range of 50 feet (15.25 meters)

MOUNTAINS OF INDIA

The Himalayas
Means 'Abode of Snow'. They are one of the youngest fold mountain ranges in the world & comprise mainly sedimentary rocks. They stretch from the Indus River in the west to the Brahmaputra River in the east. The Eastern Himalayas-made up of Patkai Hills, Naga Hills, Mizo Hills & the Garo, Khasi & Jaintia Hills-are also known as Purvanchal.
The Pamir, popularly known as the Roof of the World, is the connecting link between the Himalayas & the high ranges of Central Asia.
Can be divided into 3 parallel or longitudinal zones, each with separate features.

THE GREAT HIMALAYAS OR THE HIMADRI
There are few passes & almost all of them have a height above 4,500 m. They include Shipki La & Bara Lapcha La in Himachal Pradesh, Burzil & Zozi La in Kashmir, Niti, Lipulekh & Thag La in Uttarankhand, & Jelep La & Nathu La in Sikkim.
Average elevation extends upto 6000m & some of the world's highest peaks are here :

Mt Everest (or Sagarmatha or Chomo Langma)	8848 m (in Nepal)
Mt Kanchenjunga	8598 m (in India)
Mt Makalu	8481 m (in Nepal)
Mt Dhaulagiri	81 72 m (in Nepal)
Mt Cho Oyu	8153m (in Nepal)
Mt Nanga Parbat	8126m (in India)
Mt Annapurna	8078 m (in Nepal)
Mt Nando Devi	7817 m (in India)

LESSER HIMALAYAS OR THE HIMACHAL

Average height of mountains is 3700 – 4500 m.
Mountains & valleys are disposed in all direction (mountains rising to 5000 m & the valleys touching 1000 m).
Its important ranges are : Dhauladhar, Pir Panjal, Nag Tibba, Mussoorie.

Outer Himalayas or The Shiwaliks

Lowest range (average elevation is 900-1200 m).
Forms the foothills & lies between the Lesser Himalayas & the plains. It is the newest range.

TRANS – HIMALAYAN ZONE
This range lies to the north of the Great Himalayas. It has some important ranges like Karakoram, Laddakh, Zanskar, etc. The highest peak in this region is K2 or Godwin Austin (8611m, in Pak occupied Kashmir). Other high peaks are Hidden Peak (8068 m), Broad Peak (8047 m) & Gasherbrum II (8035 m).
The longest glacier is Siachin in the Nubra valley, which is more than 72 km long (biggest glacier in the world). Biafo, Baltaro, Batura, Hispar are the other important glaciers in this region.
This area is the largest snow-field outside the Polar Regions.
IMPORTANT FACTS
UP borders the maximum number of States-8 (Uttarakhand, HP, Haryana, Rajasthan, MP, Chhattisgarh, Jharkhand, Bihar). After UP is Assam, which touches the border of 7 States.
Tropic of Cancer passes through 8 States : Gujarat, Rajasthan, MP, Chhattisgarh, Jharkhand, WB, Tripura, Mizoram.
Indian Standard Meridian passes through 5 States : UP, MP, Chhattisgarh, Orissa, AP.
10 States form the coast of India. They are : Gujarat, Maharashtra, Goa, Karnataka, Kerala, Tamil Nadu. Andhra Pradesh, Telangana, Orissa & West Bengal.
2 Union Territories, viz. Daman & Diu & Pondicherry are also on the coast.
The Union Territories of Andaman & Nicobar Islands & Lakshadweep are made up of islands only.

THE PLAINS OF INDIA

To the south of the Himalayas & to the north of the Peninsula lies the great plains of North India. They are formed by the depositional works of three major river systems, Indus, Ganga & Brahmaputra. The vast plains of north India are alluvial in nature & the westernmost portion is occupied by the Thar Desert.
The thickness of the alluvium is maximum in the Ganga plains & minimum in the Western Plains.
The plains consist of four divisions:
Bhabar : Along the foothills of Shiwaliks. Highly porous
Tarai : Re-emergence of streams. Zone of excessive dampness
Bhangar : Older alluvium of the plains. Studded with calcareous formations called 'kankar'
Khadar : New alluvium & forms the flood plains along the river banks.

PENINSULAR PLATEAU OF INDIA

Spreads south of the Indo-Gangetic plains flanked by sea on three sides. This plateau is shaped like a triangle with its base in the north. The Eastern Ghats & the Western Ghats constitute its eastern & western boundaries, respectively.
Narmada, which flows through a rift valley, divides the region into two parts: The Malwa Plateau in the north & the Deccan Plateau in the south.
Vindhya Plateau is situated south of Malwa plateau.
Chhota Nagpur Plateau lies to the west of Bengal basin, the largest & most typical part of which is the Ranchi plateau.
The Deccan Plateau is the largest plateau in India. It is made up of lava flows in the Cretaceous-Eocene era through the fissure eruptions.

ISLANDS OF INDIA

Total coastline of India : 7516 km. Longest coastline: Gujarat (Second longest is of Andhra Pradesh).
Indian territorial limits include 248 islands:

The Andaman & Nicobar Group

Andamans is a group of 204 islands of which the largest is Middle Andaman. The Andamans are believed to be extensions of mountains system in the N.E. part of the country.
Saddle Peak (737 m) in N.Andaman is the highest peak.
The Nicobars is a group of 19 islands of which the largest is Great Nicobar. Most of them are volcanic in nature. Great Nicobar is the southernmost island & is only 147 km away from Sumatra island of Indonesia.
Volcanic Islands: Barren & Narcodam Islands. Barren is in the process of eruption these days after lying dormant for 200 years.

The Arabian Sea Group

All the islands in the Arabian Sea (Total 25) are coral islands & are surrounded by Fringing Reefs (North : Lakshadweep, South: Minicoy).

DO YOU KNOW?
Ten Degree Channel separates Andamans from Nicobars (Little Andaman from Car Nicobar)
Duncan Passage lies between South Andaman & Little Andaman.
Nine Degree Channel separates Kavaratti from Minicoy Island.
Eight Degree Channel separates Minicoy Island (India) from Maldives.

RIVERS OF INDIA

In India, the rivers can be divided into two main groups:
Himalayan Rivers--1) Indus 2) Ganga 3) Bhramputra
Peninsular Rivers--1) East flowing 2) West flowing

HIMALAYAN RIVERS OF INDIA

THE INDUS SYSTEM
It has a total length of 2880 km (709 km in India). Rises in Tibet (China) near Mansarovar Lake. In Jammu & Kashmir, its Himalayan tributaries are: Zanskar, Dras, Gartang, Shyok, Shigar, Nubra, Gilgit, etc. Its most important tributaries, which join Indus at various places, are: Jhelum, Chenab (1800 km), Ravi, Beas & Satluj.

Sources: Jhelum from Verinag (SE Kashmir), Ravi from Kullu Hills near Rohtang Pass in Himachal Pradesh, Beas from a place near Rohtang Pass in Himachal Pradesh & Satluj from Mansarovar – Rakas lakes in W. Tibet.

THE GANGA SYSTEM

It is 2525 km long of which 1450 km is in Uttarakhand & UP, 445 km in Bihar & 520 km in West Bengal. The Ganga, the head stream is constituted of two main rivers – Bhagirthi & Alaknanda, which combine at Devprayag to form Ganga.

Sources: Bhagirthi from Gaumukh, Alaknanda from Badrinath, Mandakini from Kedarnath (all from Uttarakhand).

Yamuna (1375 km) is its most important tributary (on right bank). It rises at the Yamunotri glacier in Uttarakhand. It runs parallel to Ganga for 800km & joins it at Allahabad. Important tributaries of Yamuna are Chambal, Betwa (480 km) & Ken (all from south).

Apart from Yamuna, other tributaries of Ganga are Ghaghra (1080 km), Son (780 km), Gandak (425 km), Kosi (730 km), Gomti (805 km), Damodar (541 km). Kosi is infamous as 'Sorrow of Bihar', while Damodar gets the name 'Sorrow of Bengal' as these cause floods in these regions. Hooghli is a distributory of Ganga flowing through Kolkata.

THE BRAHMAPUTRA SYSTEM

It has a total length of 2900 km. It rises in Tibet (from Chemayungdung glacier), where it is called Tsangpo, & enters the Indian territory (in Arunachal Pradesh) under the name Dihang. Important Tributaries: Subansiri, Kameng, Dhansiri, Manas, Teesta. In Bangladesh, Brahmaputra is known by the name of Jamuna while Ganga gets the name Padma. Their combined stream is known as Padma only. Meghna is the most important distributory before it enters the Bay of Bengal.

The combined stream of Ganga & Brahmaputra forms the biggest delta in the world, the Sundarbans, covering an area of 58,752 sq. km. Its major part is in Bangladesh.

On Brahmaputra is the river island, Majuli in Assam, the biggest river island in the world.

Brahmaputra, or the Red River, is navigable for a distance of 1384 km up to Dibrugarh & serves as an excellent inland water transport route.

RIVERS OF THE PENINSULA IN INDIA

A. EAST FLOWING RIVERS OF INDIA (OR DELTA FORMING RIVERS)

Mahanadi River (858 km): Rises in Raipur distt. in Chhatisgarh. **Godavari River (1465 km)** : Also called Vriddha Ganga or Dakshina Ganga. It is the longest peninsular river. Rises in Nasik. Main tributaries: Manjra, Penganga, Wardha, Indravati, Wainganga, etc.

Krishna River (1327 km): Rises in Western Ghats near Mahabaleshwar. Main tributaries: Koyna, Dudhganga, Panchganga, Malprabha, Bhima, Tungabhadra, etc.

Cauvery River (805 km): It is the largest peninsular river (maximum amount of water). Infact, it is the only peninsular river which flows almost throughout the year. Known as the 'Ganga of the South'. It rises from the Brahmagir range of Western Ghats. Main tributaries: Hemavati, Lokpawni, Shimsa.

Swarnarekha River (395 km) & Brahmani (705 km) : Rises from Ranchi Plateau.

B. WEST FLOWING RIVERS IN INDIA

Narmada River (1057 km) : Rises in Amarkantak Plateau & flows into Gulf of Khambat. It forms the famous Dhuan Dhar Falls near Jabalpur. Main tributaries: Hiran, Burhner, Banjar, Shar, Shakkar, Tawa, etc.

Tapti River (724 km) : Rises from Betul distt in Maharashtra. Also known as twin or handmaid of Narmada. Main tributaries: Purna, Betul, Arunavati, Ganjal, etc.

Sabarmati River (416 km) : Rises from Aravallis in Rajasthan.

Mahi River (560 km) : Rises from Vindhyas in Maharashtra.

Luni River (450 km) : Rises from Aravallis. Also called Salt River. It is finally lost in the marshy grounds at the head of the Rann of Kuchchh.

Sharavati is a west flowing river of the Sahyadris. It forms the famous Jog or Gersoppa or Mahatma Gandhi Falls (289 m), which is the highest waterfall in India.

Note: The largest man-made lake in India is Indira Sagar Lake, which is the reservoir of Sardar Sarovar Project, Onkareshwar Project & Maheshwar Project in Gujarat-MP.

Chilka Lake (Orissa) is the largest brackish water lake of India. Otherwise also, it is the largest lake of India. Wular Lake (J & K) is the largest fresh water lake of India. Dul Lake is also there in J & K. From Sambhar & Didwana Lake (Rajasthan), salt is produced. Other important lakes are Vembanad in Kerala & Kolleru & Pulicat in Andhra Pradesh.

The three important Gulfs in the Indian Territory are:

Gulf of Kuchch (west of Gujarat) : Region with highest potential of tidal energy generation

Gulf of Cambay or Gulf of Khambat (Gujarat) : Narmada, Tapti, Mahi & Sabarmati drain into it.

Gulf of Mannar (south east of Tamil Nadu) : Asia's first marine biosphere reserve.

IMPORTANT RIVER VALLEY PROJECTS IN INDIA

- **Bhakhra Nangal Project:** On Satluj in Punjab. Highest in India. Ht 226 m. Reservoir is called Gobind Sagar Lake
- **Mandi Project:** On Beas in H.P
- **Chambal Valley Project:** On Chambal in M.P & Rajasthan. 3 dams are there: Gandhi Sagar Dam, Rana Pratap sagar Dam & Jawahar Sagar dam
- **Damodar Valley Project:** On Damodar in Bihar.
- **Hirakud:** On Mahanadi in Orissa. World's longest dam: 4801 m
- **Rihand :** On Son(river) in Mirzapur. Reservoir is called Govind Vallabh Pant reservoir
- **Mayurkashi Project :** On Mayurkashi in W.B
- **Kakrapara Project :** On Tapi in Gujarat

- **Nizamsagar Project:** On Manjra in A.P
- **Nagarjuna Sagar Project :** On Krishna in A.P
- **Shivasamudram Project:** On Cauvery in Karnataka
- **Tata Hydel Scheme :** On Bhima in Maharashtra
- **Sharavathi Hydel Project** On Jog Falls in Karnataka
- **Kundah & Periyar Project** In TN
- **Farakka Project:** On Ganga in W.B. Apart from power & irrigation it helps to remove silt for easy navigation
- **Ukai Project :** On Tapti in Gujarat
- **Salal Project :** On Chenab in J & K
- **Mata Tila Multipurpose Project**-On Betwa in U.P & M.P
- **Thein Project :** On Ravi, Punjab
- **Pong Dam :** On Beas, Punjab

Climate of INDIA

India has tropical monsoon type of climate.

CLIMATE SEASONS IN INDIA

In India, the year can be divided into four seasons, resulting from the monsoons which occur mainly due to the differential heating of land & movement of the sun's vertical rays.

The highest temperature experienced in South is in April while in North it is in May & June. **'Cherry Blossoms'** are there in Karnataka, beneficial to coffee plantation & **'Mango showers'** in elsewhere South India, which are beneficial to mango crops.

The south – west monsoon enters the country in two currents, one blowing over the Bay of Bengal & the other over the Arabian Sea. This monsoon causes rainfall over most of the country (except Tamil Nadu & Thar Desert area).

The Bay of Bengal branch after crossing the deltaic region enters the Khasi valley in Meghalaya & gets entrapped in it due to funnel shape of the region. It strikes Cherrapunji in a perpendicular direction causing heavies rainfall in Mausryam (Approx. 1400 cm). From mid-Sept to mid-Dec, the monsoon retreats. As the sun's vertical rays start shifting towards the Tropic of Capricorn, the low pressure area starts moving south & winds finally start blowing from land to sea. This is called **north-east monsoon.** The withdrawal of monsoon is a much more gradual process than its onset. It causes rainfall in Tamil Nadu as the winds pick some moisture from Bay of Bengal. This explains the phenomenon why Tamil Nadu remains dry when the entire country receives rain & why it gets rain when practically the entire country is dry.

CLIMATIC REGIONS OF INDIA

India can be divided into a number of climatic regions.

Tropical Rain Forests in India: Found in the west coastal plains, the Western Ghats & parts of Assam. Characterised by high temperatures throughout the year. Rainfall, though seasonal, is heavy- about 200 cm annually during May-November.

Tropical Savanna Climate : In most of the peninsula region except the semi-arid zone in the leeward side of the Western Ghats. It is characterized by long dry weather throughout winter & early summer & high temperature (above 18.2 Deg.c); annual rainfall varies from 76 cm in the west to 150 cm in the east.

Tropical Semi-Arid Steppe Climate : It prevails in the rain-shadow belt running southward from Central Maharashtra to Tamil Nadu in the leeward side of the Western Ghats & the Cardamom Hills. It is characterized by low rainfall which varies from 38 cm to 80 cm, high temperature between 20 & 30.

Tropical & Subtropical Steppes : Large areas in Punjab, Haryana & Kutch region. Temperature varies from 12-35 Deg. c. The maximum temperature reaches up to 49 Deg.c. The annual rainfall, varying from 30.5-63.5 cm, is also highly erratic.

Tropical desert : This climate extends over the western parts of Banner, Jaisalmer & Bikaner districts of Rajasthan & parts of Kutch. It is characterized by scanty rainfall (30.5 cm), which is highly erratic. Rains are mostly in the form of cloud-burst. Mean monthly temperature is uniformly high (about 35c).

Humid Subtropical Climate with Dry Winters : This area includes south of the Himalayas, east of the tropical & subtropical steppes & north of tropical savannah. Winters are mild to severe while summers are extremely hot. The annual rainfall varies from 63.5 cm to more than 254 cm, most of it received during the south west monsoon season.

Mountain Climate : Such type of climate is seen in mountainous regions which rise above 6,000 m or more such as the Himalayas & the Karakoram Range.

Factors Affecting India's Climate

Latitude: The Indian landmass is equally divided by The Tropic of Cancer. Hence, half of India has tropical climate & another half has subtropical climate.

Altitude: While the average elevation in the coastal areas is about 30 metre, the average elevation in the north is about 6,000 metre. The Himalayas prevent the cold winds from Central Asia from entering the Indian subcontinent. Due to this, the subcontinent gets comparatively milder winters as compared to Central Asia.

Pressure & Winds: The Indian subcontinent lies in the region of north-easterly winds. These winds originate from the subtropical high-pressure belt of the northern hemisphere. After that, these winds blow towards south. They get deflected to the right due to the Coriolis force & then move towards the low pressure area near the equator.

Soils

1. **Alluvial Soil**:

In India it covers about 40 per cent of the total land area. It is very fertile & contributes the largest share of agricultural wealth. Found mostly in the Northern Plains, starting from Punjab in the west to West Bengal & Assam in the east. The northern parts & the coastal areas of Gujarat also have some deposits of alluvial soil.

The fine particles of sand, silt & clay are called alluvium.

The alluvial soil can be divided into

a. Old alluvium, called bangar

b. New alluvium, called khadar.

Alluvial soil is most suited to irrigation & can produce bumper crops of rice, wheat, maize, sugarcane, tobacco, cotton, jute, oilseeds, etc.

2. **Black Soil**:

The black soil is locally called regur, a word derived from Telugu word 'reguda'.

It is also called the Black Cotton Soil, as cotton is the most important crop grown in this soil.

The black soil is mostly found in the Deccan Trap, covering large areas of Maharashtra, Gujarat & western Madhya Pradesh.
The black soil is well-known for its capacity to hold moisture.
Black soil is widely used for producing cotton, wheat, linseed, millets, tobacco & oilseeds.

3. **Red Soil:**
The red soil occupies about 10 per cent area of India, mostly in the south-eastern part of the Peninsular India.
The red soil is found in Tamil Nadu, parts of Karnataka, southeast Maharashtra, eastern parts of Andhra Pradesh, Madhya Pradesh, Orissa & Jhark hand.
The red colour is due to the high percentage of iron contents.
This soil is rich in potash, but poor in lime, phosphate, nitrogen & humus.
Red soils can give excellent yields of cotton, wheat, rice, pulses, millets, tobacco, oilseeds, etc.

4. **Laterite Soil:**
The word 'laterite' has been derived from a Latin word meaning 'brick'.
It is mainly found on the summits of the Western Ghats, Eastern Ghats, Rajmahal Hills, Vindhyas, Satpuras & Malwa plateau.
It is well- developed in southern Maharashtra, & parts of Orissa, West Bengal, Karnataka, Andhra Pradesh, Kerala, Bihar, Assam & Meghalaya.
Such climatic conditions promote leaching of soil. Leaching is a process in which heavy rains wash away the fertile part of the soil.
The laterite soil is red in colour & composed of little clay & much gravel of red sandstones.
Due to intensive leaching, the laterite soil generally lacks fertility & is of low value for crop production.
But when manured & timely irrigated, the soil is suitable for producing plantation crops like tea, coffee, rubber, coconut, arecanut, etc.

5. **Mountain Soil:**
The mountain soil is generally found on the hill slopes covered with forests.
This soil is also found in the Western & Eastern Ghats & in some parts of the Peninsular India.
This soil is rich in humus, but poor in potash, phosphorus & lime.
In the Himalayan region wheat, maize, barley & temperate fruits are grown on this soil.
This soil is especially suitable for producing plantation crops, such as tea, coffee, spices & tropical fruits in Karnataka, Tamil Nadu & Kerala.

6. **Desert Soil:**
The desert soil is found mostly in the arid & semi-arid regions, receiving less than 50 cm of annual rainfall.
Such regions are mostly found in Rajasthan & the adjoining areas of Haryana & Punjab.
The Rann of Kachchh in Gujarat is an extension of this region.
The desert soil has sand (90 to 95 per cent) & clay (5 to 10 per cent). Desert soil can produce a variety of crops, such as wheat, millets, barley, maize, pulses, cotton, etc.

NATURAL VEGETATION IN INDIA

Tropical Wet Evergreen Forests-In areas over 250 cm rainfall. In Western Ghats, hilly areas in N.E. India & Andaman & Nicobar Islands. Trees are rosewood, shisham, ebony, ironwood, etc.
Tropical Moist Deciduous Forests--In areas having rainfall between 100 – 200 cm. In peninsular region & along the foothills of Himalayas in Shivaliks, Bhabhar & Tarai. The trees of these forests drop their leaves for about 6-8 weeks during the spring & early summer when sufficient moisture isn't available.
Trees are teak, sal, bamboo, sandalwood, rosewood, etc.
Thorn Forests
In areas having rainfall between 25 & 80 cm. In arid regions of Rajasthan, Punjab, Haryana & Gujarat. Trees are palm, acacia, etc.

HILL FORESTS---In hills of Southern India & the Himalayas.
The type of trees depends upon the height of the mountain : Sal & bamboo below 1000 m; oaks, chestnuts & other fruit trees, & chir forests between 1000 & 2000 m; pine, deodar, silver fern & spruce between 1600 & 3300 m; above 3600 m alpine forests with trees like silver firs, pines, birches, etc. Alpine forests give way to Alpine grasslands & scrubs as we move up further.

Tidal or Mangrove Forests
Also known as Littoral or Swamp Forests. Occur along the sea coast & in the estuaries of rivers, especially in Sunderbans & the Andamans. Most important tree is Sundari. It provides hard & durable timber which is used for construction & building purposes as well as for making boats.

IMPORTANT POINTS
Madhya Pradesh has the largest area under forests. As per percentage of forest area to total area, first is Andaman & Nicobar Islands, followed by Mizoram. In Mangrove forests, West Bengal holds the first position, followed by Gujarat & Andaman & Nicobar Islands.
The lowest forest percentage is in Haryana & Punjab, because of the extensive agriculture.

BIOSPHERE RESERVES IN INDIA
In India, the first biosphere reserve – Nilgiri biosphere reserve – came into being in 1986. So far, 14 biosphere reserves have been set up in the country.

NATIONAL PARKS & WILD LIFE SANCTUARIES

There are 96 National Parks & 510 Wildlife Sanctuaries in India.
Madhya Pradesh & Andaman & Nicobar Islands have the maximum number of National Parks (9 each) while Andaman & Nicobar Islands has 96 & Maharashtra has 36 Wildlife Sanctuaries (maximum in India).

CROPPING SEASONS IN INDIA
Kharif Crops of India

Sown in summers between May & July, & harvested after the rains, in September & October.
Eg: Rice, Jowar, Bajra, Maize, Cotton, Jute, Sugarcane, Tobacco, Groundnut, Pulses, etc.

Rabi Crops of India
Sown at the beginning of winter & harvested before the onset of the summer season, between Feb & April.
Eg: Wheat, barley, oilseeds, gram, potatoes, etc.

Zaid Crops
They are raised between April & June.
E.g. : Melon, watermelon, cucumber, toris, leafy & other vegetables.

Cash Crops of India (Commercial Crops)
Grown mainly for the market, only a small portion of the product is consumed by the farmers themselves (cotton, sugarcane etc.)

CASH CROPS	
Sugarcane	**In UP, Maharashtra, Karnataka**
Cotton	In Maharashtra, Gujarat, Andhra Pradesh
Jute & Mesta	In WB, Bihar, Asom
Tea	In Asom, West Bengal, Himachal Pradesh
Coffee	In Kamalaka, Kerala, Tamil Nadu
Rubber	In Kerala, Tamil Nadu, Karnataka
Silk	In Karnataka, Jammu & Kashmir, Andhra Pradesh. In India all 4 varieties of silk are available: Mulberry, tussar, eri & muga. Mulberry is the main variety, while tussar is mainly found in Bihar.
Tobacco	In Gujaral, Andhra Pradesh, Karnataka

Jhum
Shifting type of cultivation practiced in the hill slopes of Asom, Arunachal Pradesh, Mizoram & Nagaland. In this, the trees are felled & set on fire. The ash of the burnt trees & the other vegetation adds to the fertility of soil. This land is used for 2-3 years till the soil gets exhausted & the jhum is abandoned.

RAILWAYS IN INDIA
Indian railway system is the largest in Asia & the fourth largest in the world. It is the biggest departmental public undertaking in the country. The first train ran in India between Bombay & Thane, a stretch of 34 km. on April 16th 1853.
The second train ran between Howrah & Hooghly in 1854.
The headquarters of Indian Railway is in New Delhi.
The first electric train in India was 'Deccan Queen'. It was introduced in 1929 between Bombay & Poona.
Indian Railways has the second biggest electrified system in the world after Russia.
The fastest train in India is the Shatabadi Express whose maximum speed is 140 km/hr.
The total route covered is approx 63,000 km.
The total number of railway stations in India is 7,100.
The longest railway platforms are: Gorakhpur railway station, Uttar Pradesh, India:1,366.33 m (4,483 ft) (longest in the world).
Mumbai is the destination where maximum number of trains in India head for.
The first Metro Rail was introduced in Kolkata (W.Bengal) on October 24, 1984. The two stations connected were Dumdum & Belgachhia.

Konkan Railways India : It is a project to shorten the distance between Maharashtra, Goa & Karnataka. The total route length is 786 km between Apta (Maharashtra) & Mangalore (Karnataka).

Water Transport in India
The total length of navigable waterways in Indian comprising rivers, canals, backwaters, etc, is 14,500 km out of which 3700 km is navigable by mechanised boats.

The government has recognised the following National Waterways of India:
NW 1: Allahabad to Haldia – 1,629 kms
NW 2: Sadia to Dhubari (on Brahmaputra river) – 819 kms
NW 3: Kollam to Kottapuram – 186 kms
NW 4: Kakinada to Marakkanam (Along Godawari & Krishna river) – 1,100 kms

Ports in India
The Waterways Authority in India divides Indian ports into three categories, major, minor & intermediate. India has about 190 ports in all, with 12 major & the rest intermediate & minor.
The 12 Major Ports are:

Port	State
Kolkata (including Haldia)	West Bengal
Paradip	Orissa
Vishakhapatnam	Andhra Pradesh
Chennai	Tamil Nadu
Ennore	Tamil Nadu
Tuticorin	Tamil Nadu
Cochin	Kerala
New Mangalore	Karnataka
Mormugao	Goa
Jawaharlal Nehru	Maharashtra
Mumbai	Maharashtra
Kandla	Gujarat

BOUNDRY LINES

LINES	
Durand Line	Pakistan & Afghanistan
MacMohan Line	India & China
Radcliffe Line	India & Pakistan
Maginot Line	France & Germany
Oder Niesse Line	Germany & Poland
Hindenberg Line	Poland & Germany (at the time of First World War)
38th Parallel	North & South Korea
49th Parallel	USA & Canada

MINERALS IN INDIA
1. **IRON** :

India has huge deposits of iron-ore in Bihar, Orissa, Madhya Pradesh, Karnataka & Maharashtra. Iron-ore is found in the mines at Singhbhum in Bihar & Mayurbhanj in Orissa. Big steel plants at Jamshedpur, Bhilai, Bokaro, Durgapur, Rourkela & Bhadravati.

2.COAL :
It is known as 'black diamond'. Products like nylon, chemicals, dyes, drugs & perfumes are obtained from the distillation of coal. Coal is found in Bihar, West Bengal, Damodar Valley, Orissa, Andhra Pradesh & Madhya Pradesh. Jharia in Bihar & Raniganj in West Bengal are the largest coal mines in India. Other coal mines are located at Suhagpur (Madhya Pradesh) Dhanbad (Bihar) Neyveli (Tamil Nadu) & Singarani (Andhra Pradesh).

3. **PETROLEUM** :
Petroleum is known as 'black gold'. Petroleum is found at Digboi in Assam, Ankaieshwar & Kalol in Gujarat & Bombay High off the shore of Bombay.

4. **MANGANESE** :
Manganese is used in the manufacture of steel. India is one of the largest producers of manganese in the world. It is found in Orissa, Karnataka, Madhya Pradesh & Maharashtra.

5. **MICA** :
India is the largest producer of mica in the world. Its huge deposits are found in Gaya, Monghyr & Hazaribagh districts of Bihar.
Mica is also found in large quantities in Andhra Pradesh & Rajasthan. A large quantity of mica is exported to other countries.

6. **ALUMINIUM** :
It is a light but hard metal. The ore from which aluminum is produced is known as bauxite. Huge deposits of bauxite are found in Bihar, Orissa, Madhya Pradesh, Andhra Pradesh, Karnataka, Tamil Nadu & Maharashtra.

7. **COPPER** :
It is a good conductor of electricity. It alloys with zinc to form brass & with tin to form bronze. It occurs in small quantities in India.
It is found at Khetri in Rajasthan. Some copper has been found in Andhra Pradesh, Uttar Pradesh & Tamil Nadu.

8. **GOLD** :
Gold is produced from the mines at Kolor & Hutti in Karnataka & Anantopuram in Andhra Pradesh.

9. **DIAMOND** :
Diamonds are found in the mines at Panno in Madhya Pradesh

Area Geography & Boundaries OF INDIA

1. Geography Area of India: 32,87,263 sq. km. Accounts for 2.4% of the total world area & roughly 16% of the world population.
2. Mainland India has a coastline of 6,100 km. Including the Lakshadweep & Andaman & Nicobar Islands, the coastline measures about 7516.6 km.
3. In India, of the total land mass:
   a. Plains Geography: 43.3%
   b. Plateaus: 27.7% • Hills: 18.6%
   c. Mountains Geography: 10.7%
4. In the South, on the eastern side, the Gulf of Mannar & the Palk Strait separate India from Sri Lanka.
5. Total land neighbours: 7 (Pakistan, Afghanistan, China, Nepal, Bhutan, Bangladesh & Myanmar).
6. India's Islands include the Andaman & Nicobar Islands in Bay of Bengal & Lakshadweep, Minicoy & Amindive Islands in the Arabian Sea.

INDIA FACTS

- Highest Award-Bharat Ratna
- Highest Gallantry Award-Param Vir Chakra
- Longest Tributary river of India-Yamuna
- Largest Lake-Wular Lake, Kashmir
- Largest Lake (Saline Water)-Chilka Lake, Orrisa
- Largest Man-Made Lake-Govind Vallabh Pant Sagar (Rihand Dam)
- Highest Lake-Devtal Lake, Gadhwal (Uttarakhand)
- Highest Peak-Karkoram-2 of K-2(8,611 meters)
- Largest Populated City-Mumbai
- Largest State(Area)-Rajasthan
- Largest State(Population)-Uttar Pradesh
- Highest rainfall-Cherrapunji (426 inches per annum)
- State wise largest area under forest-Madhya Pradesh
- Largest Delta-Sunderbans Delta
- Longest River Bridge-Mahatma Gandhi Setu, Patna
- Biggest Cave temple-Ellora
- Longest Road-Grand Trunk Road
- Longest Canal-Indira Gandhi Canal or Rajasthan Canal (Rajasthan)
- Largest Museum-India Museum at Kolkata
- Longest Dam-Hirakud Dam (Orrisa)
- Highest Dam-Tehri Dam (260 meters , 850 ft)
- Largest District-Kutch district
- Longest Highway NH-44 (NH-7) which turns from Varanasi to Kanyakumari
- Smallest State (Population)-Sikkim
- Smallest State (Area)-Goa
- Largest State (Area)-Rajasthan
- Largest State (Population)-Uttar Pradesh
- Largest Cave Temple-Kailash Temple, Ellora (Maharastra)
- Largest Port-Mumbai
- Largest Church-Saint Cathedral (Goa)
- Longest Beach-Marina Beach, Chennai
- Highest Airport-Leh (Laddakh)
- Largest River Island-Majuli (Brahmaputra River, Asom)

Tectonic Plate Theory

The theory describes the large scale motion of the earth's lithosphere. This theory is based on continental drift which explains the formation of various continents over millions of years; as we see them today.

Plate Boundaries:- Based on the relative movement between two tectonic plates, there are three types of plate boundaries. They are as follows:

Convergent Boundary: In this case, the two adjacent tectonic plates move towards each other.

Divergent Boundary: In this case, the two adjacent plates move away from each other.

Transform Boundary: In this case, the two adjacent plates move along their borders.

Formation of India

The Indian Peninsula drifted towards the north & finally collided with the much larger Eurasian Plate. As a result of this collision, the sedimentary rocks which were accumulated in the geosynclines (known as Tethys) got folded & formed the mountain systems of the West Asia & Himalaya. Due to the uplift of the Himalayas in the Tethys Sea, the northern flank of the Indian Peninsula got subsided & formed a large basin. That basin was filled with sediments from the rivers which came from the mountains in the north & from the peninsula in the south. Thus, an extensive flat land of alluvial soil was formed which is known as the northern plains of India.

Major Mountain Ranges of the World

- ✓ **Andes** -South America
- ✓ **Himalayas**-Karakoram-Hindukush -South Central Asia
- ✓ **Rockies** -North America
- ✓ **Great Dividing Range**-East Australia
- ✓ **Western Ghats**-Western India-
- ✓ **Caucasus Europe**-Asia
- ✓ **Alaska** -USA
- ✓ **Alps** -Europe
- ✓ **Apennines** -Europe
- ✓ **Ural** -Asia
- ✓ **Pennines** -Europe
- ✓ **Pyrenees**-Europe-
- ✓ **Appalachian** -North America

HIMALAYAS

- **Punjab Himalaya**-Between Indus & Satluj
- **Kumaon Himalaya**-Between Satluj & Kali
- **Nepal Himalaya**-Between Kali & Tista
- **Assam Himalaya**-Between Tista & Dihang

IMPORTANT LAGOONS & LAKES

- **VEMBNAD LAKE-**Kerala -Large sized lagoons
- **KAYALS-**Kerala-Popularly called back water in Kerala. Peaty soils of backwaters are called Kari in Kerala.
- **CHILKA LAKE-**Orissa**--**south west of the Mahanadi Delta.
- **WULAR LAKE**:Jammu & Kashmir-Largest fresh water lake of India
- **KOLLERU LAKE**: Andhra Pradesh
- **PULICAT LAKE:** Andhra Pradesh
- **JAISAMAND LAKE:** Rajasthan**-**Largest fresh water lake of Rajasthan
- **NAKKI LAKE:**Rajasthan**-**small natural lake near Mt. Abu surrounded by hills important as tourist place.
- **LOKTAK LAKE**: Manipur

SALINE WATER LAKES:

SAMBHAR LAKE-Rajasthan-Largest Lake of Rajasthan lies on the border of Jaipur & Nagaur District.

DEEDWANA LAKE: Rajasthan

Green Revolution

- To increase yield per hectare government of India introduced a programme called Green Revolution.
- The Green Revolution (first) was launched in 1967-68.
- Father of Green Revolution - Dr. Norman Borlaug
- Father of Green Revolution in India - Dr. M.S. Swaminathan
- Green Revolution focused the development of high-yielding varieties of cereal grains, expansion of irrigation infrastructure, & distribution of hybridized seeds, synthetic fertilizers, & pesticides to farmers.

White Revolution

- The White Revolution in the country has been achieved by means of Operation Flood. It was carried out in three phases.
- Operation Flood I .... 1970 - 1981
- Operation Flood II ... 1981 - 1985
- Operation Flood III ... 1985 - 1996.
- White revolution launched to increase the quality & quanity of milk & dairy products.
- The Father of the White Revolution in India is Dr. Varghese Kurien. He is also known as **Milkman of India.**

REMEMBER

- **National animal-**Royal Bengal Tiger
- **National aquatic animal-**Dolphin
- **National bird-**Indian Peacock
- **National tree-**Banyan tree

Continents of the World

World Continents

- Asia, Africa, North America, South America, Europe, Australia & Antarctica are the seven continents of the world.
- These seven continents were believed to be part of Pangaea which was a single landmass around 250 million years ago.
- Due to the tectonic movement, the landmass broke up & the component continents separated & moved away to its present position. All these took around 1 million years to complete.

The Continents of the World,

- Asia Continents Countries
- Africa Continents Countries
- North America Continents Countries
- South America Continents Countries
- Europe Continents Countries
- Australia Continents Countries
- Antarctica Continents Countries

ASIA

1) Area: 44,485,900 sq Kms
2) Straits Strait of Malacca, Bering Strait.
3) **Mountains**

Pamir Knot, Himalayas, Karakoram, Kunlun, Tien Shan, Altai, Hindu Kush, Elburz, Pontic, Sulaiman, Zagros, Taurus, Urals,Yablonovoi, Stanovoi.
4) Highest Point Everest (8,848 m)
5) Lowest Point Dead Sea (396.8 m)
6) **Islands**---Kurile, Sakhalin, Honshu, Hokkaido, Taiwan, Borneo,Sumatra, Java, Celebes, New Guinea, Philippines, Sri Lanka, Bahrain, Cyprus.
7) **Rivers**-Eupharates, Tigris, Indus, Ganga, Brahmaputra, Hwang-Ho, Yang-tse, Si-kiang, Amur, Lena-Yenisei, Ob, Irrawady, Salween, Mekong.
8) **Plateaus**--Anatolia Plateau, Plateau of Iran, Plateau of Arabia, Plateau Of Tibet, Tarim Basin, Plateau of Mongolia, Plateau of Yunnan, Deccan Plateau.
9) **Peninsulas—**Kamchatka Peninsula, Peninsula of Korea, Peninsula of Indo-China, Malay Peninsula. Indian Peninsula, Arabian Peninsula.
10) Deserts-Arab, Thar

Africa
1 Area 30,259,680 sq Kms
2 Straits--Strait of Bab-el-Mandeb, Straits of Gibraltar
3 Mountains-- Atlas, Drakensberg, Kilimanjaro
4 Highest Point- Kilimanjaro (5,894 m)
5 Lowest Point-Lake Assai (-156.1 m.)
6 Islands--Madagascar, Cape Verde Islands, The Comoros, Mauritius, Seychelles
7 Plateaus--The whole continent is a plateau
8 Deserts-- Kalahari, Sahara Namib

North America
1 Area-- 24,235,280 sq Kms
2 Straits-- Bering Strait
3 Mountains-- Rockies, Appalachain, Brooks, Kuskolkwim, Alaska Range, Cascade Range, Coastal Range, Sierra Nevada, Sierra Madre
4 Highest Point-- Mckinley (6,194 m.)
5 Lowest Point--Death Valley(-85.9 m)
6 Islands--Greenland, Baffin, Victoria, Newfoundland, Cuba, Jamaica, Haiti
7 Rivers--Mississippi, Missourie, St. Lawrence, Mackenzie, Colorado, Hudson, Potomac, Ohio
8 Plateaus-- Columbia Plateau, Colorado Plateau, Mexican Plateau, Canadian Shield.
9 Deserts--Chihuahuan, Colorado, Mujave, Sonoran

South America
1 Area-- 17,820,770 sq Kms
2 Straits-- Straits of Magellan
3 Mountains-- Andes
4 Highest Point- Aconcagua (6,960 m)
5 Lowest-Point Valdes Penin (-39.9 m)
6 Islands-Galapagos, Falkland, Tierra del Fuego.
7 Rivers--Amazon, Orinoco, Paraguay, Parana, Uruguay
8 Plateaus-- Plateau of Bolivia, Plateau of Equador
9 Deserts-- Atacama, Pantagonia

Europe
1 Area -- 10,530,750 sq Kms
2 Straits-- Straits of Gibraltar
3 Mountains-- Alps, Pyrenes, Appenines, Dinaric Alps, Carpathians, Transylvanian Mountains, Balkans, Caucasus, Urals
4 Highest Point-- Elbrus (5,663 M.)
5 Lowest Point--Caspian Sea (-28.0 m)
6 Islands--British Isles, Iceland, Sardinia, Sicily,Crete.
7 Rivers--Volga, Danube, Rhine, Po, Dnieper, Don, Vistula, Elbe, Oder, Seine, Loire, Garrone, Douro, Tagus, Ural
8 Plateaus--Plateau of Bohemia, Plateau of Spain, Central Massif

Australia
1 Area-- 7,830,682 sq Kms
2 Straits-- Bass Strait
3 Mountains-- Great Dividing Range
4 Highest Point-- Kosclusko (2,228 m.)
5 Lowest Point-- Lake Eyre (-15.8 m.)
6 Islands-- Tasmania
7 Plateaus-- Western Plateau
8 Deserts-- Gibson Desert, Great Sandy Desert, Great Victoria Desert, Simpson Desert.

EUROPE CONTINENT
1) Europe ranks sixth. Its boundaries are the Arctic Ocean in the west & the Mediterranean Sea in the South. In the east, it is separated from Asia by the Ural Mountains, the Caucasus mountains & the Caspian Sea.

- Reykjavik is also known as **The Smoking Bay.**
- Denmark is the smallest country of Scandinavia.
- Greenland the world's largest island & the Faroe islands also belong to Denmark.
- Copenhagen the capital of Denmark is known as **the key to the Baltic.**
- Finland is known as the **Land of Forests & Lakes.**
- The capital & the largest city of Finland, Helsinki is known as the **White city of the North.**
- Stockholm, the capital of Sweden is known as **Beauty on the Sea.**
- Milan (Italy) is known as the **Manchester of Italy.**
- Rome is known as **City of Seven Hills**
- Vatican city is the smallest Sovereign & an independent state of the world, which is completely surrounded by Italy.

Highest point - Mt. Elbrus, Russia
Most Southerly point - Gavdos, Greece
Largest Lake - L. Ladoga, Russia
Largest river – Volga

- Russia touches fourteen other countries & crosses eight time zones.
- Moscow is a part of five seas the Baltic Sea, Lake Ladoga, the Arctic Ocean, the Black sea & the Caspian Sea.
- Mt. Blanc is the highest peak of Alps (in France)
- Important mountain ranges of Europe include Alps, Pyrenees, the Carpathian & the Caucasus.
- The highest mountain peak of Europe, Mt. Elbrus is the Caucasus.
- In the South - East part of Europe, there is an extensive grassland called the Steppes.
- Rhine is the busiest inland waterway of Europe.

- British Isles is separated from the mainland of Europe by the English Channel.
- The Pyrenees mountains separate France from Spain.
- The Ruhr (Germany) is the biggest & the richest coal producing area of Europe.

NORTH AMERICA

- Central American countries are known as the **Banana Republic.**
- Hamilton is known as **the Pittsburgh of Canada.**
- Halifax, the capital of Nova Scotia is an important ice free port in Canada.
- Vancouver, the largest city of British Columbia, Canada situated near the mouth of Fraser river.
- 'Birmingham of Canada " - Hamilton.
- Worlds largest oil refinery located on Sarnia, Canada
- Smallest state of USA : Rhode Island
- Largest state of USA : Alaska
- Largest port in Pacific, also known as **City of Golden Gate**: San Francisco, USA

Highest point - North America
Mt. Mc Kinley, Alaska, USA
Lowest Point
Death valley, California
Largest lake
L. Superior, Canada/ USA

- Largest port in USA, situated on the bank of Hudson river - New York City.
- Most populated city of USA also known as **city of sky scrapers**- New York City.
- Mauna Kea, the highest peak in Hawai is active as a volcano.
- Capital of Hawai, Honolulu is known as **the cross roads of Pacific.**
- St. Lawrence is the busiest inland waterway in North America.
- The Grand Canyon of Colorado river is the largest of its kind in the world.
- The Grasslands found in the interior plains of North America are known as the **Prairies**.
- **Lake Superior :** World's second largest lake after Caspian Sea.
- **Lake Michigan :** Only Great lake that is entirely within the United States.
- World's leading coffee producer : Brazil
- Largest city of South America : Sao Paulo, Brazil
- Driest place in the world : Arica, Chile
- World's largest copper town : Chiquicamata, Chile
- **Pearl of the Pacific**: Guayaquil, Ecuador
- World's highest water fall : Angel falls, Venezuela
- Strait between South America & Antarctica : Drake Passage.
- Highest active volcano in the world : Mt. Ojas del Salado, Argentina
- Second highest mountain systems in the world next to the Himalayas : Andes
- Amazon basin is the home of the rubber tree.

AUSTRALIA

- Australia is the smallest continent.
- It lies entirely in the Southern Hemisphere.
- Australia is the only country in the world that covers the entire continent.
- It is also known as **the Island Continent.**
- Tropic of Capricon passes almost through the middle of the continent.
- Australia was discovered by captain James Cook, an English Seaman, in 1770.
- It is surrounded by Timor Sea in the northwest, Arafura sea & Gulf of Carpentaria in the north, Great Barrier Reef in the north east & Great Australian Bight in the South.

Highest point
Mt. Kosciusko, Australia
Lowest point : Lake Eyre, Australia
Largest Lake : Lake Eyre

- The Murray & the Darling are the major rivers of Australia.
- Tropical grasslands are called Savannas & the temperate grasslands found in the
- Murray Darling basin are called Downs.
- Sydney is the largest city & important sea port of Australia.
- Tasman sea separates Australia from New Zealand.

New Zealand is divided into two islands: The Northern Island & the Southern Island. Cook strait seperates the two islands.
Wellington the Capital lies in the Northern Island.

ANTARCTICA

- Antarctica is Earth's southernmost continent, underlying the South Pole.
- It is situated in the Antarctica region of the southern hemisphere, almost entirely south of the Antarctic Circle, & is surrounded by the Southern Ocean.

Highest point : Vinson Massif, 4,897 m
Lowest point : Bentley Subglacial Trench, -2,555 m
Longest river : Onyx River, 25 km

FACTS

Largest total area ... Russia, 17,098,242 km^2
Largest land area... Russia, 17,075,200 km^2
Largest water area... Canada, 891,163 km^2
Longest coastline ... Canada, 243,792 km
Highest coastline to area ratio ... Micronesia, 8,706.553 m/km^2
Most countries bordered: **...**Russia & China
Largest forest area ... Russia, 8,087,900 km^2

Hottest, Coldest, Driest,Wettest

Hottest Place Dalol, Denakil Depression, Ethiopia, annual average temperature (93.2°F, 34°C)
Coldest Place Plateau Station, Antarctica, annual average temperature (-56.7°C)
Wettest Place Mawsynram, Assam, India, annual average rainfall (11,873 mm, 467.4")
Driest Place Atacama Desert, Chile, imperceptible rainfall on a yearly basis.

Important mountain ranges

Andes -- South America
Rockies -- North America

Atlas --- Africa
Kilimancharo --- Africa
Appalechian--- America
Ural ---Europe
Alps ---Europe
Karpathyan ---Europe
Mount Eribus --- Antartica
Himalayam --- Asia

VOLCANOES

Important volcanoes
Vezuvias --- Italy
Etna --- Italy
Stromboli ---Italy
Barren--- India (Andaman Nicobar)
Kilimancharo --- Tanzania
Krakathove--- Indonesia
Pina thubo --- Philippense

- Most of the volcanoes found near Pacific Ocean
- Ring of fire - Pacific
- Lighthouse of the Pacific - Ezalko
- Lighthouse of the Mediteranian - Stromboli

DESERTS

Fozil desert--- Kalahari
Little Sahara --- Australia
Death desert--- Thakkala Makkan
Painted desert --- North America
Coldest desert --- Gobi
Warmest desert --- Sahara
Driest desert--- Attakkama
Great Indian desert --- Thar

Important Deserts

Roob Asavali	-- Asia
Attakkama	-- South America
Sahara	-- Africa
Kalahari	-- Africa
Nameeb	--Nameebia
Great Sandy	--Australia
Great Victoria	-- Australia
Thakkala Makkan	--China
Sahel	--China
Thar	-- India

ISLANDS

Island of the volcanoes	-- Iceland
Island of the tortoise	-- Galappagose
Island of the Sailors	-- Samova
Island of the inspiration	-- Tazmania
Pearl of the Antilles	-- Cuba
Friendly island	---- Tonga
Spring island	----Jamaica
Birthplace of Napolean	-- Kozhsikka Island
Biggest island	--Greenland
Smallest island nation	-- Navru

Folkland islands, Canari islands, Kozhzikka, St. Helena, Bahamas Burmuda islands situated in Atlantic Ocean.

MEDEIVAL HISTORY

THE CHALUKYAS

1. Pulakesin I (543-566) was the first independent ruler of Badami with Vatapi in Bijapur as his capital.
2. Kirthivarma I (566-596) succeeded him at the throne. When he died, the heir to the throne, Prince Pulakesin II, was just a baby & so the king's brother, Mangalesha (597-610), was crowned the caretaker ruler. Over the years, he made many unsuccessful attempts to kill the prince but was ultimately killed himself by the prince & his friends.
3. Pulakesin II (610-642), the son of Pulakesin I, was a contemporary of Harshavardhana & the most famous of the Chalukyan kings.His reign is remembered as the greatest period in the history of Karnataka. He defeated Harshavardhana on the banks of the Narmada.

4. After conquering the Kosalas & the Kalingas, & eastern Chalukyan dynasty was inaugurated by his(Pulakeshin II) brother Kubja Vishnuvardana.
5. By 631, the Chalukyan empire extended from sea to sea. However, Pulkeshin II was defeated & probably killed in 642, when the Pallavas under Narsimhavarma I attack on their capital & captured the chalukyan capital at Badami.
6. The Chalukyas rose to power once again under the leadership of Vikramaditya I (655-681), who defeated his contemporary Pandya, Pallava, Cholas & Kerala rulers to establish the supremacy of the Chalukyan empire in the region.
7. Vikramaditya II (733-745) defeated the Pallava king Nandivarma II to capture a major portion of the Pallava kingdom.
8. Vikramaditya II's son, Kirtivarma II (745), was disposed by the Rastrakuta ruler, Dhantidurga, who established the Rashtrakuta dynasty.

THE CHOLAS (9TH TO 13TH CENTURY)

1. The Chola dynasty was one of the most popular dynasties of south India which ruled over Tamil Nadu & parts of Karnataka with Tanjore as its capital.
2. Early Chola rulers were the Karikala Cholas who ruled in the 2nd century.
3. In 850, Vijayalaya captured Tanjore during the Pandya-Pallava wars. To commemorate his accession, he built a temple at Tanjore. The giant statue of Gomateswara at Shravanbelagola was also built during this period.
4. Vijayalaya's son Aditya I (871-901) succeeded him to throne.
5. It was Rajaraj I (985-1014) during which the CHOLAS reached at its zenith. He snatched back lost territories from the Rashtrakutas & become the most powerful of the Chola rulers. Rajaraja' is also famous for the beautiful shiva temple which he constructed at Thanjavur(TN). It is called Rajarajeswara after his name.
6. Rajendra Chola (1014-1044), son of Rajaraja I, was an important ruler of this dynasty who conquered Orissa, Bengal, Burma & the Andaman & Nicobar Island. The Cholas dynasty was at its zenith also during his reign. He also conquered Sri Lanka.
7. Kulottunga I (1070-1122) was another significant Chola ruler. Kulottunga I united the two kingdom of the eastern Chalukyas of Vengi & the Cholas of Thanjavur. After a long reign of about half a century, Kulottunga I passed away sometime in 1122 & was succeeded by his son, Vikrama Chola, surnamed Tyagasamudra.
9. The last ruler of the Chola Dynasty was Rajendra III (1246-79). He was a weak ruler who surrendered to the pandyas. Later, Malik Kafur invaded this Tamil state in 1310 & extinguished the Chola empire.

THE GHAZNAVIS

Mahmud of Ghazni (997-1030)

a) He was also known as "But-Shikan" (destroyer of the image) because of seventeen plundering expeditions between 1000 AD & 1027 AD in India.
b) Annexing Punjab as his eastern province, he claimed to have come here with twin objectives of spreading Islam in India, & enriching himself by taking away wealth from India.
c) In 1025, he attacked & raided the most celebrated Hindu temple of Somnath, Gujarat.
d) Beruni who wrote Kitab-ul Hind, & Firdausi, who wrote Shah Namah, were the court Historians of Mahmud Ghazni & give a good account of the polity & society on the eve of Mahmood's invasion. From 1010 to 1026, the invasions were thus directed toward the temple-towns of Thaneswar, Mathura, Kannauj & finally Somnath.

Muhammad Ghori (Shahabuddin Muhammad)

In AD 1173 Shahabuddin Muhammad (AD 1173–1206) also called Muhammad of Ghori ascended the throne of Ghazni. The Ghoris were not strong enough to meet the growing power & strength of the Khwarizmi Empire; they realized that they could gain nothing in Central Asia.

Conquest of Punjab & Sind

a) Muhammad Ghori led his first expedition in AD 1175. He marched against Multan & freed it from its ruler. In the same campaign he captured Uchch from the Bhatti Rajputs.
b) Three years later in AD 1178 he again marched to conquer Gujarat but the Chalukya ruler of Gujarat, Bhima II defeated him at the battle of Anhilwara. But by AD 1190 having secured Multan, Sind & Punjab, Muhammad Ghori paved the way for a further thrust into the Gangetic Doab.

Delhi Sultanate

After the assassination of Muhammad Ghori, **Qutubuddin Aibek got the control over Delhi**
This period can be divided into 5 distinct periods viz.
1. The Slave Dynasty (1206-90)
2. The Khilji Dynasty (1290-1320)
3. The Tughlaq Dynasty (1320-1414)
4. The Sayyid Dynasty (1414-51)
5. The Lodhi Dynasty (1451-1526).

The Slave Dynasty

Qutubuddin Aibak (1206-10)

• A Turkish slave by origin, he was purchased by Mohammad Ghori who later made him his Governor.
• After the death of Ghori, Aibak became the master of Hindustan & founded the Slave Dynasty in 1206.
• The capital during his reign was not Delhi but **Lahore**.
• For his generosity, he was given the title of **Lakh Bakhsh** (giver of lakhs).
• He died in 1210 while playing Chaugan or Polo.
• He constructed two mosques i.e. Quwat-ul-Islam at Delhi & Adhai din ka Jonpra at Ajmer.
• He also began the construction of Qutub Minar, in the honour of famous Sufi Saint Khwaja Qutibuddin Bakhtiyar Kaki.
• Aibak was great patron of learning & patronized writers like Hasan-un-Nizami, author of 'Taj-ul- Massir' & Fakhruddin, author of 'Tarikh-i-Mubarak Shahi'.

Aram Shah (1210)

- He was the son of Aibak, who was defeated by Illtutmish in the battle of Jud.

Shamsuddin Illtutmish (1210-36)

- He was a slave of Qutubuddin Aibak of Mamluke tribe & occupied the throne of Delhi in 1211.
- Illtutmish began his career as Sar-e Jandhar or royal bodyguard.
- He was a very capable ruler & is regarded as the 'real founder of the Delhi Sultanate'.
- He made Delhi the capital in place of Lahore.
- He saved Delhi Sultanate from the attack of Chengiz Khan, the Mongol leader, by refusing shelter to Khwarizm Shah, whom Chengiz was chasing.
- He introduced the silver coin (tanka) & the copper coin (jital).
- He organized the Iqta System & introduced reforms in civil administration & army, which was now centrally paid & recruited.
- He set up an official nobility of slaves known as Chahalgani/ Chalisa (group of forty).
- He completed the construction of Qutub Minar which was started by Aibak.
- He patronized Minhaj-us-Siraj, author of 'Tabaqat-i-Nasiri'.

Ruknuddin : 1236

- He was son of Illtutmish & was crowned by her mother, Shah Turkan, after death of Illtutmish.
- He was deposed by Razia, daughter of Illtutmish.

Razia Sultana: (1236 – 40)

- Iltutmish had nominated his daughter Razia as the successor, the nobles placed Ruknuddin Feroz on the throne.
- She was the 'first & only Muslim lady who ever ruled India'.
- She use to rule without the veil
- She further offended the nobles by her preference for an Abyssian slave Yakut.
- The wazir of Illtutmish Junnaidi revolted against her but was defeated.
- There was a serious rebellion in Bhatinda, Altunia, governor of Bhatinda refused to accept suzerainity of Razia. Razia accompanied by Yakut marched against Altunia.
- However, Altunia got Yakut murdered & imprisoned Razia.
- Subsequently, Razia was married to Altunia & both of them marched towards Delhi as nobles in Delhi raised Bahram Shah (3rd son of Illtutmish) to throne.
- In 1240 AD, Razia became the victim of a conspiracy & was assassinated near Kaithal (Haryana).

Bahram Shah: 1240-42

- Iltutamish's third son Bahram Shah was put on throne by powerful Turkish council Chalisa.
- He was killed by Turkish nobles.

Allauddin Masud Shah: 1242-46

- He was son of Ruknuddin Feroz.
- He was disposed after Balban & Nasiruddin Mahmud's Mother, Malika-e-Jahan, conspired against him & established Nasiruddin Mahamud as the new Sultan.

Nasiruddin Mahmud 1246-66

- He was the eldest son of Illtutmish.
- Minaj-us-Siraj has dedicated his book Tabaquat-i-Nasiri to him

Ghiyasuddin Balban : 1266-87

- After the death of Nasiruddin; Balban ascended the throne in 1266.
- He broke the power of Chalisa & restored the prestige of the crown. He made kingship a serious profession.
- The Persian court model influenced Balban's conception of Kingship. He took up the title of Zil-i-Ilahi (Shadow of God).
- He introduced Sijda (prostration before the monarch) & Paibos (kissing the feet of monarch) as the normal forms of salutation.
- Divine right of the king was emphasized by calling himself Zil-i-Ilahi.
- He gave great emphasis on justice & maintaining law & order.
- He established the military department Diwan-i-Arz.
- In his last days he overlooked Sultanate affairs due to death of his eldest & most loving son, Muhammad, & rebellion by his closest & most loved slave, Tughril. Muhammad died fighting Mongolians in 1285 & Tughril was captured & beheaded.

Kaiqubad: 1287-90

- He was the grandson of Balban was established on the throne by Fakruddin, the Kotwal of Delhi
- But Kaiqubad was killed by nobles Kaimur
- He was the minor son of Kaiqubad who came to throne at an age of 3
- He was the last Illbari ruler
- The Khalji nobles revolted against him & he was killed within three months.

The Khalji dynasty (1290-1320 A.D.)

Jallauddin Khalji

- Jalaluddin Khilji founded the Khilji dynasty.
- He was a liberal ruler & adopted the policy of religious toleration
- His son-in-law & nephew was Allauddin Khalji

Allauddin Khalji

- He was the first Turkish Sultan of Delhi who separated religion from politics. He proclaimed 'Kingship knows no Kinship'.
- During the reign of Jallauddin Khalji, he was the governor of Kara
- He adopted the title Sikander-e-Saini or the second Alexander
- Alauddin annexed Gujarat (1298), Ranthambhor (1301), Mewar (1303), Malwa (1305), Jalor (1311).
- In Deccan, Aluddin's army led by Malik Kafur defeated Ram Chandra (Yadava ruler of Devagiri), Pratap Rudradeva (Kakatiya ruler of Warangal), Vir Ballal III (Hoyasala ruler of Dwarsamudra) & Vir Pandya (Pandya ruler of Madurai).
- Malik Kafur was awarded the title Malik Naib

Administrative & Market reforms during Allauddin

- Alauddin issued 4 ordinances.

1. Aimed at confiscation of the religious endowments & free grants of lands.
2. Reorganized the spy system.
3. Prohibited the use of wine.

4. Nobles should not have convivial parties & they should not inter-marry without his permission.

- He introduced the system of Dagh (the branding of horse) & Chehra (descriptive roll of soldiers).
- Alauddin ordered that all land was to be measured & then they share of state was to be fixed.
- The post of special officer called Mustakharaj was created for the purpose of collection of revenue.
- Alauddin sought to fix cost of all commodities.
- All goods for sale were brought to an open market called Sara-i-Adal.
- Many forts were built by him & the most important of them was Alai fort. He also constructed the Alai Darwaja, the entrance gate of Qutub Minar. He also built the Palace of thousand Pillars called Hazar Sutun.
- He was a patron of art & learning. Amir Khusrau, the poet-musician was his favorite court poet.

Malik Kafur

- In 1316, after death of Alauddin, Malik Kafur seized the throne.
- Before Kafur died, he nominated Shihabuddin (Alauddin's 6 year old prince) as King but imprisoned eldest prince Mubarak Khan.
- Kafur was killed by the loyalists of the royal family of Alauddin.

Shiabuddin Umar (1316)

- He was the minor son of Jhitaipali who was raised to throne after the death of Allauddin.
- He became victim of the court politics & was later blinded.

Mubarak Khalji (1316-20)

- He released 18,000 prisoners
- He reversed all the administrative & market reforms of Allauddin Khalji.
- During his time Devgiri was annexed.

The Thuglaq Dynasty

Ghiyasuddin Tughlaq

- Ghazi Malik or Ghiyasuddin Tughlaq of Qaurana tribe was the founder of Tughlaq dynasty.
- He was the governor of Dipalpur before coming to power as Sultan
- He died in the collapse of the victory pavilion near Delhi

Mohammad Bin Tughlaq (1325-51)

- Prince Jauna, son of Ghiyasuddin Tughlaq ascended the throne in 1325.
- He gained the title Ulugh Khan, he was most educated of all the Sultans of the Delhi Sultanate
- He created a department Diwan-e-Amir-e-Kohi for the improvement of the agriculture
- He distributed Sondhar i.e. agriculture loans advanced for extension of agriculture of barren land
- He encouraged cash crops in place of cereals

Jalaluddin Ahsan Shah

1336: Foundation of Vijayanagar by Harihar & Bukka; & Warangal became independent under Kanhaiya.

The five experiments

- **Taxation in the Doab**: The Sultan made an ill-advised financial experiment in the Doab between the Ganges & Yamuna. The Sultan crated a new department of Agriculture called Diwan-i-Kohi.
- **Transfer of Capital**: The most controversial step which Mohammad-bin Tughlaq under took soon after his accession was the so called transfer of capital from Delhi to Devagiri. Devagiri was thus named Daulatabad.
- **Introduction of Token Currency:** Mohammad-bin-Tughlaq decided to introduce bronze coins, which were to have same value as the silver coins.
- **Proposed Khurasan Expedition:** The Sultan had a vision of universal conquest. He decided to conquest Khurasan & Iraq & mobalised a huge army for the purpose. He was encouraged to do so by Khurasani nobles who had taken shelter in his court. Moreover there was instability in Khurasan on account of the unpopular rule of Abu Said. This project was also abandoned because of the change in political scenarioin Khurasan.
- **Qarachil Expedition:** This expedition was launched in Kumaon hills in Himalayas allegedly to counter Chinese incursions.It also appears that the expedition was directed against some refractory tribes in Kumaon-Garhwal region with the object of bringing them under Delhi Sultanate. The first attack was a success but when the rainy season set in, the invaders suffered terribly.
- He died in Thatta while campaigning in Sindh against Taghi, a Turkish slave.

Feroz Shah Tughlaq (1351-88)

- He was a cousin of Mohammad-bin Tughlaq.
- He adopted the policy of appeasement with the nobility, the army & theologians
- The new system of taxation was according to quran. Four kinds of taxes sanctioned by the Quran were imposed & those were Kharaj, Zakat, Jizya & Khams. Kharaj was the land tax, which was equal to 1/10 of the produce of the land, Zakat was 2% tax on property, Jizya was levied on non-Muslims & Khams was 1/5 of the booty captured during war.
- Firoz tried to ban practices, which the orthodox theologians considered non Islamic. Thus he prohibited the practice of Muslim women going out to worship at graves of saints & erased paintings from the palace.
- It was during the time of Firoz that Jizya became a separate tax.
- In order to encourage agriculture, the Sulatan paid a lot of attention to irrigation. Firoz repaired a number of canals & imposed Haque-i-Sharb or water tax
- He was a great builder as well; to his credit are cities of Fatehabad, Hisar, Jaunpur & Firozabad.
- The two pillars of Ashoka, one from Topra (Haryana) & other from Meerut (U.P.) were brought to Delhi.
- The Sultan established at Delhi, a hospital described as Dar-ul-Shifa.
- A new department of Diwan-i-Khairat was set up to make provisions for marriage of poor girls.
- However his rule is marked by peace & tranquility & credit for it goes to his PM Khan-i- Jahan Maqbul.
- He died in 1388.

The Sayyaid dynasty

- Khizr Khan (1414-21)
- Mubarak Shah (1421-34)
- Muhammad Shah (1434-43)
- Alam Shah (1443-51)--He was the last Sayyid king descended in favour of Bahlol Lodhi & he retired. Thus began the Lodhi dynasty.

The Lodi Dynasty

Bahlol Lodhi : 1451-88

- Bahlol Lodhi was one of the Afghan sardars who established himself in Punjab after the invasion of Timur.
- He founded the Lodhi dynasty.
- Jaunpur was annexed into Delhi Sultanat during his reign

Sikandar Lodhi : 1489-1517

- Sikandar Lodi was the son of Bahlol Lodhi who conquered Bihar & Western Bengal.
- Agra city was founded by him.
- Sikandar was a fanatical Muslim & he broke the sacred images of the Jwalamukhi Temple at Nagar Kot & ordered the temples of Mathura to be destroyed.
- He reimposed Jaziya tax on non muslims
- He use to write poems with the pen name "Gulrukhi"
- He took a keen interest in the development of agriculture. He introduced the Gaz-i-Sikandari (Sikandar's yard) of 32 digits for measuring cultivated fields.

Ibrahim Lodhi : 1517-26

- He was the last king of the Lodhi dynasty & the last Sultan of Delhi.
- He was the son of Sikandar Lodhi.
- At last Daulat Khan Lodhi, the governor of Punja invited Babur to overthrow Ibrahim Lodhi.
- Babur accepted the offer & inflicted a crushing defeat on Ibrahim Lodhi in the first battle of Panipat in 1526.
- He was the only Sultan who died in battle field

2.2 Administration under Sultanate

• There were four pillars of the state i.e.:
Diwan-i-Wizarat or finance department
Diwan-i-Risalat or department of religious matters & appeals
Diwan-i-Arz or department of military affairs
Diwan-i-Insha or department of royal correspondence

2.3 Art & architecture under Delhi Sultanate

• The new features brought by the Turkish conquerors were :
The dome
The lofty towers
The true arch unsupported by beam
The vault.

- Aibak built a Jami Masjid & Quwwatul Islam mosque, he also began the construction of Qutub Minar
- Aibak also built the Adhai-din ka Jhonpra at Ajmer has a beautiful prayer hall, an exquisitely carved Mehrab of white marble & a decorative arch screen.
- The first example of true or arch is aid to be the tomb of Ghiyasuddin Balban in Mehrauli (Delhi).
- Allauddin Khalji began the work of Alai minar to rival Qutab Minar, but this could'nt be completed because of his death
- Some notable Tughlaq monuments are the fort of Tughlaquabad, the tomb of Ghiyasuddin Tughlaq which marked a new phase in Indo-Islamic architecture.

Mughal period

Babur

- The foundation of the Mughal rule in India was laid by Babur in 1526.
- He was a descendant of Timur (from the side of his father) & Chengiz Khan (from the side of his mother).
- Babur was invited by Daulat Kahna Lodi & Alam Khan Lodi against Ibrahim Lodi
- Babur defeated Ibrahim Lodhi in the first battle of Panipat on April 21, 1526 & established Mughal dynasty.
- In 1527, he defeated Rana Sanga of Mewar at Khanwa.
- In 1528, he defeated Medini Rai of Chaneri at Chanderi.
- In 1529, he defeated Muhammad Lodhi (uncle of Ibrahim Lodhi) at Ghaghra.
- In 1530, he died at Agra. His tomb is at Lahore. The tomb of only two Mughal emperors are outside India i.e. Babur & Bahadur Shah Zafar
- He was the first to use gunpowder & artillery in India.
- Two gun masters Mustafa & Ustad Ali were in his army
- He wrote his autobiography Tuzuk-i-Baburi in Turki .
- Tuzuk-i-Baburi was translated in Persian (named Baburnama) by Abdur Rahim Khan-e-khana & in English by Madan Bebridge.
- He compiled two anthologies of poems, Diwan (in Turki) & Mubaiyan (in Persian). He also wrote Risal-i-Usaz or letters of Babur.

Humayun (1530-40 & 1555-56)

- He was the son of Babur & ascended the throne in 1530. His succession was challenged by his brothers Kamran, Hindal & Askari along with the Afghans.
- In 1532 he established Tabl-e-adl at Agra.
- He fought two battles against Sher Shah at Chausa (1539) & at Kannauj/Bilgram (1540) & was completely defeated by him.
- He escaped to Iran where he passed 12 years of his life in exile.
- After Sher Shah's death Humayun invaded India in 1555 & defeated his brothers the Afghans. He once again became the ruler of India.
- He died while climbing down the stairs of his library (at Din Panah) in 1556 & was buried in Delhi.
- Abul Fazal calls him Insan-e-Kamil.
- His sister, Gulbadan Begum wrote his biography Humayunama.
- He built Din Panah at Delhi as his second capital.

Sur Empire (Second Afghan Empire) 1540-55

Sher Shah: 1540-45

- He was the son of Hasan Khan, the Jagirdar of Sasaram.
- In 1539, he defeated Humayun in the battle of Chausa & assumed the title Sher Shah as emperor.
- As an emperor, he conquested Malwa (1542), Ranthambhor (1542), Raisin (1543), Rajputana annexation of Marwar (1542), Chittor (1544) & Kalinjar (1545). He died in 1545 while conquesting Kalinjar.
- Purana Quila was built during his reign

- During his brief reign of 5 years he introduced a brilliant administration, land revenue policy & several other measures to improve economic conditions of his subjects.
- He issued the coin called **Rupiah** & fixed standard weights & measures all over the empire.
- He also improved communications by building several highways. He built the Grand Trunk Road (G.T. Road), which runs from Calcutta to Peshawar. The other roads built during his reign were:
  Agra to Mandu
  Agra to Jodhpur & Chittor
  Lahore to Multan
- He set up cantonment in various parts of his empire & strong garrison was posted in each cantonments.
- According to Abul Fazal the empire of Sher Shah was divided into 63 sarkars or districts.
- The unit of land measurement was "bigha"
- He like Allauddin Khalji introduced Dagh & Chera in the army
- Zamindars were removed & the taxes were directly collected.
- He was buried in Sasaram.

Akbar

- Akbar, the eldest son of Humayun, ascended the throne under the title of Jalaluddin Muhammad Akbar Badshah Ghazi at the young age of 14.
- His coronation took place at Kalanaur.
- Second Battle of Panipat (5 Nov., 1556) was fought between Hemu (the Hindu General of Muhammad Adil Shah) & Biram Khan (the regent of Akbar). Hemu was defeated, captured & slain by Bairam Khan.
- In the initial years of his rule Akbar was first under the influence of his reagent Bairam & then under her mother Maha Manga.
- The period of influence of Maham Anga on Akbar i.e. form 1560-62 is known as the period of Petticoat government.
- Age of marriage for boys & girls was increased to 16 years & 14 years respectively
- **Sati was prohibited**
- In his 24th year Akbar introduced Dashala system for the collection of land revenue by the state.
- The Mansabdari system under Akbar, divided the Mansabdars into 66 categories. **This system fixed the following service conditions:**
  Rank & status
  Salary
  Number of sawars (horsemen)
- As a revolt against the orthodoxy & bigotry of religious priests, Akbar proclaimed a new religion, Din-i-Ilahi, in 1581. Birbal was the only Hindu who followed this new religion.
- Akbar built Fatehpur Sikri, Agra Fort, Lahore Fort & Allahabad Fort & Humayun's Tomb at Delhi. Fatehpur Sikri, place near Agra-it said that Akbar had no son for a long time. Sheikh Salim Chisti, a Sufi saint blessed Akbar with a son who was named Salim/Sheikho Baba (Jahangir). In honour of Salim Chisti, Akbar Shifted his court from Agra to Fatehpur Sikri.
- Tulsidas (author of Ramcharitmanas) also lived during Akbar's period.
- When Akbar died, he was buried at Sikandara near Agra.
- Birbal was killed in the battle with Yusufzai Tribe (1586).
- Abul Fazl was murdered by Bir Singh Bundela (1601).
- Akbar gave Mughal India one official language (Persian).

Jahangir (1605-27)

- Salim, son of Akbar, came to the throne after Akbar's death in 1605.
- He established Zanjir-i-Adal (i.e. Chain of Justice) at Agra Fort for the seekers of royal justice.
- In 1611, Jahangir married Mihar-un-nisa, widow of Sher Afghan, a Persian nobleman who was sent on expedition to Bengal. Later on she was given the title Nurjahan.
- Nurjahan excercised tremendous influence over the state affairs. She was made the official Padshah Begum.
- Jahangir issued coins jointly in Jurjahan's name & his own.
- Jahangir also married Jodha Bai of Marwar.
- In 1608, Captain William Hawkins, a representative of East India Company came to Jahangir's court. In 1615 Sir Thomas Roe, an ambassador of King James I of England also came to his court.He granted permission to the English to establish a trading port at Surat.
- His reign was marked by several revolts. His son Khusrau, who received patronage of 5th Sikh Guru Arjun Dev, revolted against Jahangir (1605). Arjun Dev was later sentenced to death for his blessing to the rebel prince (1606).
- During his last period, Khurram (Shanjahan), son of Jahangir, & Mahavat Khan, military general of Jahangir also revolted (Khurram: 1622-25 & Mahavat Kha : 1626-27).
- He wrote his memories Tuzuk-i-Jahangiri in Persian.
- He was buried in Lahore.

Shah Jahan

- His real name was Khurram, he was born to Jodha Bai (daughter of Raja Jagat Singh).
- Shahjahan ascended the throne in 1628 after his father's death.
- Three years after his accession, his beloved wife Mumtaj Mahal (original name- Arzumand Bano) died in 1631. To perpetuate her memory he built the Taj Mahal at Agra in 1632-53.
- He continued applying tika (tilak) on the fore-head
- He introduced the Char-Taslim in the court
- In addition to Jahangir's empire, Nizam Shahi's dynasty of Ahmadnagar was brought under Mughal control (1633) by Shahjahan.
- Shahjahan's reign is described by French traveler Bernier & Tavernier & the Italian traveler Nicoli Manucci. Peter Mundi described the famine that occurred during Shahjahan's time.
- The Red Fort, Jama Masjid & Taj Mahal are some of the magnificent structures built during his reign.
- Shahjahan's failing health set off the war of succession among his four sons in 1657.
- Aurangzeb emerged the victor who crowned himself in July 1658. Shahjahan was imprisoned by his son Aurangzeb in the Agra Fort where he died in captivity in 1666. He was buried at Taj (Agra).

Aurangzeb

- The war of succession took place in the later stage of the Shah Jahan reign.

- His four sons Dara Shikoa, Aurangzeb, Shah Shuja & Murad were in the state of war for the throne.
- His daughters also supported one son or the other in the tussle for throne Janah Ara supported Dara. Roshan Ara supported Aurangzeb. Guhara supported Murad.
- Aurangzeb was coroneted twice, he was the only Mughal king to be coroneted twice
- Barnier was the foreign visitor who saw the public disgrace of Dara after he was finally deafeated in war at Deorai.
- During the first 23 years of the rule (1658-81) Aurangazeb concentrated on North India. During this period the Marathas under Shivaji rose to power & were a force to reckon with.
- Highest numbers of Hindu Mansabdars were there in the service of Mughals during the reign of Aurangzeb.
- Aurangzeb captured Guru Teg Bahadur, the 9th Guru of Sikhs in 1675 & executed him when he refused to embrace Islam.
- The 10th & last Sikh Guru, Guru Gobind Singh, son of Guru Teg Bahadur, organized his followers into militant force called Khalsa to avenge the murder of his father.
- Guru Gobind Singh was, however murdered in 1708 by an Afghan in Deccan. Banda Bahadur, the militant successor of Guru Gobind Singh continued the war against Mughals.

Religious policy of Aurangzeb:

- He was called Zindapir or living saint
- Muhatasibs were appointed for regulation of moral conduct of the subjects
- He forbade singing in the court, but allowed musical instruments. He himself played Veena
- He ended Jhoraka darshan started by Akbar
- He ordered that no new Hindu temples were to be built. Old temples were allowed to be repaired
- The Viswanath temple at Kashi & the Keshav Rai temple of Bir Singh Bundela at Mathura were destroyed
- In 1679 he re-imposed Jaziya tax

CLASH WITH MARATHAS

- Shivaji was the most powerful Maratha king & an arch enemy of Aurangzeb.
- When Aurangzeb could not eliminate him, he conspired with Jai Singh of Amber, a Rajput, to eliminate Shivaji in 1665.
- On the assurance given by Jai Singh, Shivaji visited Aurangzeb's court. Shivaji was imprisoned by Aurangzeb but he managed to escape & in 1674 proclaimed himself an independent monarch.
- Shivaji died in 1680 & was succeeded by his son Sambhaji, who was executed by Aurangzeb in 1689. Sambhaji was succeeded by his brother Rajaram & after his death in 1700, his widow Tarabai carried on the movements.

Mughal administration

Mansabdari system:

- Each Mughal officer was assigned a mansab (rank), there were 66 categories of Mansabdars
- Jahangir introduced Du-Aspah-Sih-Aspah system whereby the specific noble was to maintain double the number of horsemen.

Central administration:

Wakil: He was initially the PM, however later became revenue advisor only
Mir Bakshi: He was the head of military department

Provincial administration:

- The empire was divided into provinces or Subas.
- In 1580, Akbar divided the empire into 12 provinces. The number of provinces became 15 towards the end of his reign.
- In Jahangir's reign the number of provinces rose to 17 & further in Aurangzeb's reign to 21
- The Nazim or Subedar was the head of provinces

Local administration:

- The provinces were divided into Sarkars, which were sub divide into Parganas & further into villages

Mughal Culture

- Jahangir's reign was the apex culmination for the Mughal painting while that of Shah Jahan was the apex culmination for architecture.
- Babur built two mosques, one at Kabulibagh in Panipat & the other at Sambhal in Rohilakhand.
- Humayun's tomb was built by his widow Haji Banu Begum.
- The Mariam's palace, Diwan-i-Aam, Diwan-i-Khas at Sikri are Indian in their plan.
- Buland Darwaja (built after Gujarat victory), formed the main entrance to Fatehpur Sikri.
- Salim Chisti's tomb (redone in Marble by Jahangir) is the first Mughal building in pure marble). Palace of Birbal & palace of Tansen are also inside the Fatehpur Sikri.
- Akbar also began to build his own tomb at Sikandara which was later completed by Jahangir.
- The architecture of Fatehpur Sikri is known as Epic in red sand stone.
- Nurjahan built Itimad-ud-daula or Mirza Ghiyas Beg's marble tomb at Agra, which is noticable for the first use of Pietra Dura (floral designs made up of semiprecious stones) technique.
- Jahangir built Moti Masjid in Lahore & his mausoleum at Shahdara (Lahore).
- Some of the important buildings built by Shahajahan at Agra are Moti Masjid (only Mosque of marble). Khaas Mahal, Mussmman Burz (Jasmine Palace where he spent his last year in captivity) etc.
- He laid the foundations of Shahjahanabad in 1637 where he built the Red Fort & Takht-i-Taus (Peacock throne).
- Only building by Aurangzeb in the Red Fort is Moti Masjid.
- Only monument associated with Aurangzeb is Bibi ka Makbara which is the tomb of his wife Rabbiaud-daura in Aurangabad.
- Aurangzeb also built the Badshahi Masjid in Lahore.
- Humayun had taken into his service two master painter Mir Syed Ali & Abdus Samad.
- Daswant & Basawan were two famous painters of Akbar's court.
- Abdul Hassan, Ustad Mansur & Bishandas were three famous painters of Jahangir's court.

The landmark events that took place during the reign of Akbar

1562 Ban on forcible conversion of war-prisoners into slaves
1563 Abolition of Pilgrimage Tax
1564 Abolition of Jaziya
1571 Foundation of Fatehpur Sikri
1579 Proclamation of 'Mazhar' (written by Faizi)
1580 Dahsala Bandobast introduced
1582 Din-i-Ilahi / Tauhid-i-Ilahi
1584 Ilahi Samvat i.e. Calender
1587 Ilahi Gaz i.e. Yard

Mughal Literature

- Akbar Nama--Abul Fazl
- Tobaqat-i-Akbari--Khwajah Nazamuddin Ahmad Baksh
- Iqbalnama-i-Jahangiri—Muhammad Khan
- Ain-i-Akbari --Abul Fazl
- Padshah Namah-- Abdul Hamid Lahori
- Shahjahan Namah-- Muhammad Salih
- Sirr-i-Akbar-- Dara Shikoh
- Safinat-ul-Auliya -- Dara Shikoh
- Majma-ul-Bahrain -- Dara Shikoh
- Raqqat-e-Alamgiri – Aurangzeb

Mughals After Aurangzeb

1. Which Mughal ruler in Indian history as "Shah-e.-Bekhabar?" Ans. Bahadur Shah.
2. During the reign of which Mughal ruler there was a Sikh rising in Punjab under the leadership of Banda Bahadur? Ans. Bahadur Shah.
1. Who abolished the Jazia tax reimposed by Aurangzeb ? Ans. Jahandar Shah.
2. Who was Ahmad Shah Abdali ?
3. Ans. He was the Defense Minister of Nadir Shah.
4. Between whom the third battle of Panipat was fought & when ? Ans. Ahmad Shah Abdali & the Marathas in 1761 AD?
5. Which Mughal ruler participated in the battle of Buxar in 1764 AD, in favour of Mir Qasim of Bengal & Nawab' of Avadh Shuja-ud-Daula against the British rule?
6. Ans. Shah Alam II.
7. Which Mughal ruler had to grant the Diwani of Bengal, Bihar & Orissa to the British after the battle of Buxar? Ans. Shah Alam II.
8. Who was the last ruler of Mughal dynasty ? Ans. Bahadur Shah Zafar.
9. Where Bahadur Shah Zafar was deposed in capital? Ans. Rangoon.
10. Where Bahadur Shah Zafar died ? Ans. In Rangoon.
11. 11Who is the **architect** of **Tajmahal** ? Answer: **Uztad Iza**
12. What is the Gate way of **Redfort** called as ? Answer: **Lahore Gate**
13. Which is the biggest masjid in India ? Answer: **Jama Masjid in delhi**

Bahadur Shah 1 (1707-12)

- Muzam succeeded Aurungzeb after latter's death in 1707
- He acquired the title of Bahadur Shah.
- Granted sardeshmukhi to Marathas but not Chauth
- Released Shahuji (son of Sambhaji) from prison (who later fought with Tarabai)
- Tried to make peace with Guru Gobind Sahib by giving him a high Mansab.
- After Guru's death, Sikhs again revolted under the leadership of Banda Bahadur. This led to a prolonged war with the Sikhs.
- Made peace with Chhatarsal, the Bundela chief & Churaman, the Jat chief.

Jahandar Shah (1712-13)

- Death of Bahadur Shah plunged the empire into a civil war
- Jahandar Shah, son of Bahadur Shah, ascended the throne in 1712 with help from Zulfikar Khan
- Zulfikar Khan, his wazir, was virtually the head of the administration
- ZK abolished jizyah
- Peace with Rajputs: Jai Singh of Amber was made the Governor of Malwa. Ajit
- Singh of Marwar was made the Governor of Gujarat.
- Chauth & Sardeshmukh granted to Marathas. However, Mughals were to collect it & then hand it over to the Marathas.
- Ijarah: (revenue farming) the government began tcontract with revenue farmers & middlemen to pay the government a fixed amount of money while they were left free to collect whatever they could from the peasants
- Jahandhar Shah defeated in January 1713 by his nephew Farrukh Siyar at Agra

Farrukh Siyar (1713-19)

- Owed his victory to Saiyid Brothers: Hussain Ali Khan Barahow & Abdullah Khan
- Abdullah Khan: Wazir, Hussain Ali: Mir Bakshi
- FS was an incapable ruler. Saiyid brothers were the real rulers.

Saiyid Brothers

1. Known the Indian History as King Makers
2. Adopted the policy of religious tolerance. Abolished jizyah.
3. Pilgrim tax was abolished from a number of places
4. Marathas: Granted Shahuji swarajya & the right to collect chauth & sardeshmukhi of the six provinces of the Deccan
5. They failed in their effort to contain rebellion because they were faced with constant political rivalry, quarrels & conspiracies at the court.
6. Nobles headed by Nizam-ul-Mulk & Muhammad Amin Khan began to conspire against them
7. In 1719, the Saiyid Brothers killed & overthrew Siyar.

Muhammad Shah 'Rangeela' (1719-1748)

- Weak-minded, frivolous & over-fond of a life of ease
- Neglected the affairs of the state
- Naizam ul Mulk Qin Qulik Khan, the wazir, relinquished his office & founded the state of Hyderabad in 1724
- "His departure was symbolic of the flight of loyalty & virtue from the Empire"
- Heriditary nawabs arose in Bengal, Hyderabad, Awadh & Punjab
- Marathas conquered Malwa, Gujarat & Bundelkhand

Nadir Shah's Invasion (1738)

- Attracted to India by its fabulous wealth.
- The twarmies met at Karnal on 13th Feb 1739. Mughal army was summarily defeated. MS taken prisoner

- Massacre in Delhi in response to the killing of some of his soldiers.
- Plunder of about 70 crore rupees. Carried away the Peacock throne & Koh-inoor
- MS ceded thim all the provinces of the Empire west of the river Indus
- Significance: Nadir Shah's invasion exposed the hidden weakness of the empire to the Maratha sardars & the foreign trading companies

Ahmed Shah Abdali

- One of the generals of Nadir Shah
- Repeatedly invaded & plundered India right down to Delhi & Mathura between 1748 & 1761. He invaded India five times.
- 1761: Third battle of Panipat. Defeat of Marathas.
- As a result of invasions of Nadir Shah & Ahmed Shah, the Mughal empire ceased to be an all-India empire. By 1761 it was reduced merely to the Kingdom of Delhi

Shah Alam II (1759)

- Ahmed Bahadur (1748-54) succeeded Muhammad Shah
- Ahmed Bahadur was succeeded by Alamgir II (1754-59)
- 1756: Abdali plundered Mathura
- Alamgir II was succeeded by Shah Jahan III
- Shah Jahan III succeeded by Shah Alam II in 1759
- Shah Alam spent initial years wandering for he lived under the fear of his wazir.
- In 1764, he joined forces with Mir Qasim of Bengal & Shuja-ud-Daula of Awadh in declaring a war upon the British East India company. This resulted in the Battle of Buxar
- Pensioned at Allahabad.
- Returned to Delhi in 1772 under the protection of Marathas.

Decline of the Mughal Empire

- After 1759, Mughal empire ceased to be a military power.
- It continued from 1759 till 1857 only due to the powerful hold that the Mughal dynasty had on the minds of the people of India as a symbol of the political unity of the country
- In 1803, the British occupied Delhi
- From 1803 to 1857, the Mughal emperors merely served as a political front of the British.
- The most important consequence of the fall of the Mughal empire was that it paved way for the British to conquer India as there was no other Indian power strong enough to unite & hold India.

The Marathas

2.1 Shivaji (1627-80)

- Shivaji was the son of Shahji & Jijabai & was born in the fort of Shivner.
- Shivaji inherited the Jagir of Poona from his father in 1637.
- His guru was Ramdas Samrath
- After the death of his guardian, Dadaji Kondadev, in 1647, he assumed full charge of his Jagir.
- He conquered many Forts viz.

1. Singh Garh/ Kondana (1643)
2. Rohind & Chakan (1644-45)
3. Toran (1646)
4. Purandhar (1648)
5. Rajgarh/ Raigarh (1656)
6. Supa (1656)
7. Panhala (1659).

- In 1657 Shivaji first confronted the Mughals, talking advantage of the Mughal invasion of Bijapur, he raided Ahamadnagar & plundered Junnar.
- In 1659-60, Afzal Khan was deputed by Adil Shah of Bijapur to punish Shivaji; but the later Afzal Khan was murdered by Shivaji in 1659. The famous "baghnakh" episode is related with the death of Afzal Khan.
- In 1660, Shaista Khan, governor of Deccan, was deputed by Aurangzeb to check Marathas. Shivaji lost Poona, Kalyan & Chakan also suffered several defeats till he made a bold attack on Shaista Khan(1663) & plundered Surat (1664) & later Ahmadnagar.
- Raja Jai Singh of Amber & Diler Khan were then appointed by Aurangzeb to curb the rising power of Shivaji in 1665.
- Jai Singh succeeded in beseiging Shivaji in the fort of Purandhar. Consequently the treaty of Purandhar (1665) was signed according to which Shivaji ceded some forts to the Mughals & paid a visit to the Mughal court at Agra.
- In 1666, Shivaji visited Agra but there he was insulted
- In 1670, Shivaji captured most of the forts lost by the treaty of Purandhar.
- In 1674 Shivaji was coronated at capital Raigarh & assumed the title of Haindava Dharmodharak (Protector of Hinduism).
- After that Shivaji continued the struggle with Mughals & Siddis (Janjira). He conquested Karnataka during 1677-80.
- His last expedition was against Ginjee & Vellore.

Shivaji's Administration

- Swarajya was directly under the control of Maratha.
- Chauth & Sardeshmukhi were taxes collected by Marathas.
- Chauth was paid to the Marathas so as not be subjected to Maratha raids.
- Sardeshmukhi was an additional levy of 10% on those lands of Maharashtra over which the Maratha claimed hereditary rights, but which formed part of the Mughal Empire.
- Marathi became the official language.
- Shivaji divided his territory under his rule (Swarajya) into three provinces, each under a viceroy. Provinces were divided into Prants which were subdivided into parganas or tarafs.
- Shivaji was helped by the Ashtapradhan (Eight-minister) which was unlike a council of ministers, for there was no collective responsibility; each minister was directly responsible to Shivaji.

Shivaji's Ashtapradhan

1. Peshwa (Mukhya Pradhan): Finance & general administration, later he became PM & assumed great importance.

2. Sar-i-Naubat (Senapati): Military commander. This is an honorary post with no real military powers.

- Later on the ninth minister named Pratinidhi was added by Raja Ram a successor of Shivaji
- Most of the administrative reforms of Shivaji were based on Malik Ambar's (Ahmadnagar) reforms.

2.2 Successors of Shivaji

Shambhaji: 1680-1689

- Sambhaji, the elder son of Shivaji, defeated Rajaram, the younger son of Shivaji, in the war of succession.
- He provided protection & support to Akbar II, the rebellious son of Aurangzeb.
- He was captured at Sangameswar by a Mughal noble & executed(killed).

Rajaram: 1689-1700

- He succeeded the throne with the help of the ministers at Rajgarh.
- He fled from Rajgarh to Jinji in 1689 due to a Mughal invasion in which Rajgarh was captured along with Sambhaji's wife & son (Shahu) by the Mughals.
- Rajaram died at Satara, which had become the capital after the fall of Jinji to Mughal in 1698.
- Rajaram created the new post of Pratinidhi, thus taking the total number of minister to nine (Pratinidhi+Ashtapradhan).

Tarabai: 1700-1707

- Rajaram was succeeded by his minor son Shivaji II under the guardianship of his mother Tarabai.
- Tarabai continued the struggle with Mughals

Shahu : 1707-1749

- Shahu was released by the Mughal emperor Bahadur Shah.
- Tarabai's army was defeated by Shahu at the battle of Khed (1700) & Shahu occupied Satara.
- Shahu's reign saw the rise of Peshwas & transformation of the Maratha kingdom into an empire based on the principle of confederacy.

Balaji Viswanath (1714-20): The First Peshwa

- He began his carrier as a small revenue official & was given the title of Sena Karte (marker of the army) by Shahu in 1708.
- He became Peshwa in 1713 & made the post the most important & powerful as well as hereditary.
- He concluded an agreement with the Syed Brothers-King Maker (1719) by which the Mughal emperor Farrukhsiyar recognised Shahu as the king of the Swarajya.

Baji Rao I: 1720-40

- Baji Rao, the eldest son of Balaji Viswanath, succeeded him as Peshwa at the young age of 20.
- He was considered the greatest exponent of guerrilla tactics after Shivaji & Maratha power reached its zenith under him.
- Under him several Maratha families became prominent & got themselves entrenched in different parts of India.
- He conquered Bassein and

Salsette from the Portuguese (1739).

- He also defeated the Nizam-ul-Mulk near Bhopal & concluded the treaty of Doraha Sarai by which he got Malwa & Bundelkhand from the latter (1738).
- He said about Mughals: 'Let us strike at the trunk of the withering tree & the branches will fall of themselves'.

Balaji Baji Rao: 1740-61

- Popularly known as Nana Saheb, he succeeded his father at the age of 20.
- After the death of Shahu (1749), the management of all state affairs was left in his hands.
- In an agreement with the Mughal emperor Ahmad Shah, the Peshwa was to protect the Mughal empire from internal & external enemies (like Ahmad Shah Abdali) in return for Chauth (1752).
- Third battle of Panipat (Jan 14, 1761) resulted in the defeat of the Marathas by Ahmad Shah Abdali & the death of Viswas Rao & Sadashiv Rao Bhau. This event shocked the Peshwa Balaji Baji Rao & after six month he also died. This battle ended the Maratha power.

QUESTIONS

1. Who was the first person to unite the Marathas ? Ans. Shivaji.
2. Who was the founder of Marathas empire ? Ans. Shivaji.
3. What was the dream of Shivaji ? Ans. To establish a vast Marathas empire & drag foreigners out of the country.
4. By whom was shivaji greatly impressed ? Ans. His mother Jija Bai.
5. What was Shivaji's first Military achievement ? Ans. His first military achievement was the capturing of the Torna Fort of Bijapur in 1446 AD.
6. When & where Shivaji made his capital ? Ans. 1656 AD, Raigarh.
7. When did Shivaji fight a war with Bijapur state ? Ans. In 1659 AD, Afzal Khan of Bijapur was killed in this war . & Shivaji got a huge looty.
8. Aurangzeb sent whom against Shivaji ? Ans. Shaista Khan, but he had to flee from the battle field.
9. Shivaji plundered which city of Gujarat & when ? Ans. Surat, in 1664 AD.
10. To crush whom did Aurangzeb send Raja Jaisingh of Amber ? Ans. Shivaji. Raja Jai Singh captured many Marathas forts & compelled him to make peace.
11. Between whom the treaty of Purandara was singned? Ans. Shivaji & Aurangzeb.
12. When did Shivaji attend the court of Aurangzeb ? Ans. In 1666 AD.
13. When was Shivaji imprisoned in the court of Aurangzeb ? Ans. In 1666 AD.
14. When did Shivaji again loot Surat ? Ans. In 1670 AD.
15. When did Shivaji celebrate his coronation ? Ans. In 1674 AD.
16. Which of his son did Shivaji send in the service of Aurangzeb ? Ans. Shambhaji.
17. By how many ministers Shivaji was assisted Ans. Eight ministers.
18. The council of eight ministers of Shivaji was known by which name ? Ans. Ashtha Pradhan.
19. Which was the most important post in Shivaji's council ? Ans. Peshwa (PM).
20. Which was the second most important post in Shivaji's council ? Ans. Amatya (Finance Minister).
21. What was the tax system of Shivaji ? Ans. The land revenue was fixed at 2/5th of the total produce. The Chauth & the Sardeshmukhi were also the main source of income of the state.

22. What was the Chauth ? Ans. Shivaji used to plunder the neighboring states & small principalities. They were always in fear of Shivaji's raid. They entered into an agreement with Shivaji & he assured them not to attack & plunder them by paying a tax called Chauth. The Chauth was l/4th of the standard revenue.
23. What was Sardeshmukhi ? Ans. Sardeshmukhi was also a tax paid by the territories & principalities so that Marathas might also fight for them & save them from other invaders. Sardeshmukhi was charged 1/4th the standard revenue.
24. Aurangzeb called whom by the name of "Pahari Chuha" ? Ans. Shivaji.
25. In which war strategy Marathas were very popular ? Ans. Guerilla war.
26. Which title did Shivaji assume & swear for the protection of Brahmans ? Ans. Hindu Padshahi & saviour of the religion.
27. When did Shivaji die ? Ans. In 1680 AD.

Important battles fought in India

Battle of Tarain (First)(1191)-This battle was fought at Tarain near Thaneswar. Prithviraj of Chauhan
Dynasty defeated the Mohammad of Ghori

Second Battle of Tarain(1192)-It was fought at same Tarain battlefield as in the first Tarain battle. This was fought by Mohammad Ghori against Prithvi Raj Chauhan. This time Prithvi Raj was defeated.

Battle of Khanwa(17-March-1527)--Rajputs under Rana of Mewar Rana Sanga, were defeated by Babur of Ferghana. Rana Sanga was brutally wounded in the battlefield.

Battle of chausa (7-June-1539)
Sher shah defeated the mughals, but Humayun, the king escaped by crossing over the river.

Battle of Kanauj or Billgram (17-May-1540)
Sher shah won against Humayun. Occupied only Agra city.

Battle of Panipat(5-November-1556)
Hem Chandra Vikramaditya (Hemu) was defeated by Mughals under Akbar.

Battle of Haldighati(1576)
This was started between Akbar & Rana of Mewar Pratap. Mughals won. But Rana did not accept Mughal sovereignty.

First Carnatic War(1745–48)
This war was fought by British & French armies. French occupied Madras, later returned it to British.

Second Carnatic War(1749–54)
French army under the of Duplex fought with British & British won. In 1755 they made a provisional treaty.

Third Carnatic War(1756–63)
In 1758 French occupied Fort Saint David. But defeated at Wandiwasi (1760). Britishers won.

Battle of Plassey (June-1757)
British Army under the command of Rober Clive fought with Bengal Nawab Siraz-ud-daula & British won & Mir Jafar was made Nawab. Siraz-ud-daula was hanged.

Battle of Buxar(1764)
British army under the command of Major Manri defeated the combined army of Mir Kasim nawab of Bengal, Shuja-ud-daulah nawab of Awadh, Sha Alam, Mughal emperor.

History of Important battles & wars in India

Battle of Hydaspes (326 B.C)— The Paurava king Porus was defeated by Alexander the Great.But the valour of Porus impressed Alexander & he returned his kingdom to him.

Battle of Kalinga (261 B.C)— Ashoka defeated Kalinga king. After this war Ashoka embraced Buddhism & preached it during the rest of his life.

Battle of Chhandwar (1194 A.D)-Mohammed Ghori defeated Jayachandra of Kannauj.

First Battle of Panipat (1526 A.D)—Babur (Mughal Dynasty) defeated Ibrahim Lodhi.

Battle of Talikota (1564- 65 AD)— Alliance between Bijapur, Bidar, Ahmednagar & Golkonda under Hussain Nizam Shah defeated Ram Raja of Vijayanagar Empire.

First Anglo-Mysore War (1767–1769) —Between the Sultanate of Mysore & the East India Company. British were defeated.

First Anglo-Maratha War (1775–1782 A.D)- Fought between the British East India Company & Maratha Empire in India.Maratha defeated English forces ended with Treaty of Salbai.All the territories occupied by the British after the treaty of Purandar were given back to the Marathas.

Second Anglo-Mysore War (1780 A.D)— Alliance between Haider Ali, the Nizam & the Marathas was formed. They defeated the English.Hyder Ali became the master of Carnatic.

Third Anglo-Mysore War (1790- 92 A.D)—Fought between the English & Tipu Sultan (Son of Hyder Ali). Tipu Sultan was compelled to sign the Treaty of Seringapatam.

Fourth Anglo-Mysore War (1799 A.D)— The British forces (Under Arthur Wellesley) defeated & killed Tipu Sultan.

Second Anglo-Maratha War (1803-1805 A.D)—Fought between English & the Marathas.British defeated Marathas & annexed Tanjore, Surat & Carnatic.

Third Anglo-Maratha War (1817–1818 A.D)- Fought between English (Governor General Hastings) & the Marathas.British defeated Marathas.Formal end of the
Maratha empire

First Anglo-Burmese War (1824–1826) Fought between English East India Company & Burma.Ended in a British East India Company victory.

First Anglo-Afghan war (1839-42 A.D)- British defeated Afghan ruler Dost Mohammad.

Battle of Cheelianwala (1849 A.D)— English East India Company under Lord Hugh Gough defeated the Sikhs (under Sher Singh).

ANCIENT INDIAN HISTORY

INDUS VALLEY CIVILIZATION IN INDIA

Ancient Civilizations in India

- The Indus Valley Civilization was an ancient civilization thriving along the Indus River & the Ghaggar-Hakra River in what is now Pakistan & north-western India.
- According to radio-carbon dating, it spread from the year 2500 – 1750 BC.
- R.B. Dayaram Sahni first discovered Harappa (on Ravi) in 1921. R.D. Banerjee discovered Mohenjodaro or 'Mound of the Dead' (on Indus) in 1922. Sir John Marshal played a crucial role in both these.

- Harappan Civilization forms part of the proto history of India & belongs to the Bronze Age.
- Copper, bronze, silver, gold were known but not iron.
- The Indus-Valley people were well-acquainted with the use both of cotton & wool.

Domestication of animals:

- Stock breeding was important in Indus culture. Besides sheep & goats, dogs, humped cattle buffalo & elephant was certainly domesticated. The camel was rare & horse was not known.

Indus Valley Civilization Town Planning :

- Elaborate town-planning. It followed the Grid System. Roads were well cut, dividing the town into large rectangular or square blocks
- Used burnt bricks of good quality as the building material. Elsewhere in the contemporary world, mud-bricks were used.
- In Mohanjodaro, a big public bath (Great Bath) measuring 12 m by 7 m & 2.4 m deep, has been found. Steps led from either end to the surface, with changing rooms alongside. It was probably used for ritual bathing.

Major Cities & Their Features:

- Mohenjodaro (Sind) is situated on the right bank of the Indus.
- Chanhudaro lies on the left bank of the Indus about 130 km south of Mohenjodaro.
- Kalibangan (Rajasthan) was on the banks of the river Ghaggar which dried up centuries ago.
- Lothal is at the head of the Gulf of Cambay.
- Banawali (Haryana) was situated on the banks of the now extinct Sarasvati River.
- Surkotada (Gujarat) is at the head of the Rann of Kutch.
- Dholavira (Gujarat) excavated is in the Kutch district

Trade & Commerce in Ancient India :

- There was no metallic money in circulation & trade was carried through Barter System
- Weights & measures of accuracy existed in Harappan culture (found at Lothal). The weights were made of limestone, steatite, etc & were generally cubical in shape.
- 16 was the unit of measurement (16, 64,160, 320).
- A dockyard has been discovered at Lothal. Rangpur, Somnath & Balakot functioned as seaports. Sutkagendor & Sutkakoh functioned as outlets.

Indus Valley Civilization Script :

- The script is not alphabetical but pictographic (about 600 undeciphered pictographs).
- The script has not been deciphered so far, but overlaps of letters show that it was written from right to left in the first line & left to right in the second line. This style is called 'Boustrophedon'

BUDDHISM IN INDIA

- Born in 563 BC on the Vaishakha Poornima Day at Lumbini (near Kapilavastu) in Nepal.
- His father Suddhodana was the Saka ruler.
- His mother (Mahamaya, of Kosala dynasty) died after 7 days of his birth. Brought up by stepmother Gautami.
- Married at 16 to Yoshodhara. Enjoyed the married life for 13 years & had a son named Rahula.
- Left his palace at 29 (with Channa, the charioteer & his favourite horse, Kanthaka) in search of truth (also called 'Mahabhinishkramana' or The Great Renunciation) & wandered for 6 years.
- Attained 'Nirvana' or 'Enlightenment' at 35 at Gaya in Magadha (Bihar) under the Pipal tree.
- Delivered the first sermon at Sarnath where his five disciples had settled. His first sermon is called 'Dharmachakrapravartan' or 'Turning of the Wheel of Law'.
- Attained Mahaparinirvana at Kushinagar (identical with village Kasia in Deoria district of UP) in 483 BC at the age of 80 in the Malla republic.

Buddhist Councils:

- The monks gathered 4 times after the death of Buddha & the effect of these events had their effect on Buddhism.
- **First Council:** At Rajgriha, in 483 BC under the chairman ship of Mehakassaapa (King was Ajatshatru). Divided the teachings of Buddha into two Pitakas – Vihaya Pitaka & Sutta Pitaka. Upali recited the Vinaya Pitaka & Ananda recited the Sutta Pitaka.
- **Second Council:** At Vaishali, in 383 BC under Sabakami (King was Kalasoka). Followers divided into Sthavirmadins & Mahasanghikas.
- **Third Council:** At Pataliputra, in 250 BC under Mogaliputta Tissa (King was Ashoka). In this, the third part of the Tripitaka was coded in the Pali language.
- **Fourth Council:** At Kashmir (Kundalvan), in 72 AD under Vasumitra (King was Kanishka). Vice-Chairman was Ashwaghosha). Divided Buddhism into Mahayana & Hinayana sects.

Buddist Literature:

- Buddhist scriptures in Pali are commonly referred to as Tripitakas, i.e. **'Threefold Basket'.**
- **Vinaya Pitaka:** Rules of discipline in Buddhist monasteries.
- **Sutta Pitaka:** Largest, contains collection of Buddha's sermons.
- **Abhidhamma Pitaka:** Explanation of the philosophical principles of the Buddhist religion.

JAINISM IN INDIA

- Founded by Rishabhanath.
- There were 24 tirthankaras (Prophetsor Gurus), all Kshatriyas.
- First was Rishabhanath (Emblem: Bull).
- The 23rd Tirthankar Parshwanath (Emblem: Snake) was the son of King Ashvasena of Banaras. His main teachings were: Non-injury, Non-lying, Non-stealing, Non-possession.
- The 24th & the last Tirthankar was Vardhman Mahavira (Emblem: Lion).

Vardhman Mahavira History:

- He was born in Kundagram (Distt Muzafffarpur, Bihar) in 599 BC.
- His father Siddhartha was the head of Jnatrika clan. His mother was Trishla, sister of Lichchavi Prince Chetak of Vaishali.
- Mahavira was related to Bimbisara.
- Married to Yashoda, had a daughter named Priyadarsena, whose husband Jamali became his first disciple.
- At 30, after the death of his parents, he became an ascetic.
- In the 13th year of his asceticism (on the 10th of Vaishakha), outside the town of Jrimbhikgrama, he attained supreme knowledge (Kaivalya).
- From now on he was called Jaina or Jitendriya & Mahavira, & his followers were named Jains. He also got the title of Arihant, i.e., worthy.

- At the age of 72, he attained death at Pava, near Patna, in 527 BC.

Note: In Jainism, three Ratnas (Triratnas) are given & they are called the way to Nirvana. They are Right Faith, Right Knowledge & Right Conduct.

History of Jain Councils:

- **First Council:** Held at Pataliputra by Sthulabhadra in the beginning of third century BC. It resulted in the compilation of 12 Angas to replace 14 Purvas.
- **Second Council:** It was held at Vallabhi (Gujarat) in the fifth century AD under the leadership of Devridhigani.

THE MAGADHA EMPIRE

- **Period of Magadha Empire:** 6th Century – 4th Century BC.
- **Extent of Magadha Empire:** Magadha embraced the former districts of Patna, Gaya & parts of Shahabad & grew to be the leading state of the time.
- **Haryanka Dynasty:** Originally founded in 566 BC by the grandfather of Bimbisara, but actual foundation by Bimbisara.

King Bimbisara of Magadha (544 BC – 492 BC):

- Contemporary of Buddha.
- His capital was Rajgir (Girivraja)
- His capital was surrounded by 5 hills, the openings in which were closed by stone walls on all sides. This made Rajgir

Ajatshatru History (492 BC – 460 BC):.

- Son of Bimbisara killed his father & seized the throne.
- Buddha died during his reign; arranged the first Buddhist Council.
- **History of Udayin (460 – 444 BC):** He founded the new capital at Pataliputra, situated at the confluence of the Ganga & Son.

Shishunaga Dynasty:

- Founded by a minister Shishunaga. He was succeeded by Kalasoka (II Buddhist council).
- Dynasty lasted for two generations only.
- Greatest achievement was the destruction of power of Avanti.

Nanda Dynasty:

- Founder was Mahapadma Nanda.
- Alexander attacked India in their reign. Dhana Nanda was there at that time.

Alexander's Invasion of India

- Alexander (356 BC – 323 BC) was the son of Philip of Macedonia (Greece) who invaded India in 326 BC.
- At that time NW India was split up into a number of small independent states like Taxila, Punjab (kingdom of Porus), Gandhara etc.
- Except Porus who fought the famous battle of Hydaspes (on banks of Jhelum) with Alexander, all other kings submitted meekly.
- Except Porus who fought the famous battle of Hydaspes (on banks of Jhelum) with Alexander, all other kings submitted meekly.
- When Alexander reached Beas, his soldiers refused to go further, so he was forced to retreat.
- To mark the farthest point of his advance, he erected 12 huge stones altars on the northern bank of Beas.
- Remained in India for 19 months & died in 323 BC at Babylon.

THE MAURYAN DYNASTY

Chandragupta Maurya History (322 – 297 BC):

- With the help of Chanakya, known as Kautilya or Vishnugupta, he overthrew the Nandas & established the rule of the Maurya dynasty.
- Built a vast empire, which included not only good portions of Bihar & Bengal, but also western & north western India & the Deccan.
- This account is given by Megasthenes (A Greek ambassador sent by Seleucus to the court of Chandragupta Maurya) in his book Indica. We also get the details from the Arthashastra of Kautilya
- Chandragupta adopted Jainism & went to Sravanabelagola (near Mysore) with Bhadrabahu, where he died by slow starvation.

History of Bindusara (297 – 273 BC):

- Chandragupta Maurya was succeeded by his son Bindusara in 297 BC.
- He is said to have conquered 'the land between the 2 seas', i.e., the Arabian Sea & Bay of Bengal.

History of Ashoka (269 – 232 BC):

- Ashoka was appointed the Viceroy of Taxila & Ujjain by his father, Bindusara
- Ashoka became the Buddhist under Upagupta.

The Kalinga War History:

(261 BC, mentioned in XIII rock edict): It changed his attitude towards life. Ashoka became a Buddhist after that.

Causes of the fall of Mauryan Empire:

- Ashoka's patronage of Buddhism & his anti-sacrificial attitude is said to have affected the income of the Brahmins. So they developed antipathy against Ashoka.
- Revenue from agrarian areas was not sufficient to maintain such a vast empire as booty from war was negligible.
- Successors of Ashoka were too weak to keep together such a large centralized empire.

Note: The last Mauryan king Brihadratha was killed by Pushyamitra Shunga (Commander in Chief) in 185 BC, who started the Shunga dynasty in Magadha.

SANGAM AGE IN INDIA

History of Cholas:

- The kingdom was called Cholamandalam or Coromondal. The chief centre was Uraiyur, a place famous for cotton trade. Capital was Kaveripattanam/Puhar.
- A Chola king named Elara conquered SriLanka & ruled it over for 50 years.
- Karikala was their famous king.
- Main source of wealth was trade in cotton cloth. They also maintained an efficient navy.

THE GUPTA DYNASTY

Gupta Empire Golden Age of India

- On the ruins of the Kushan empire arose a new empire, which established its way over a good part of the former dominions of both Kushans & Satavahanas. The first two kings of the dynasty were Srigupta & Ghatotkacha.

Chandragupta I (AD 319 – 335):

- First important king of Gupta Dynasty.
- Started the Gupta era in 319-320 AD.
- He enhanced his power & prestige by marrying Kumara Devi, princes of the Lichchavi clan of Nepal.
- He acquired the title of Maharajadhiraj.
- Struck coins in the joint names of himself, his queen & the Lachchavi nation, thereby acknowledging his marriage alliance.

History of Samudragupta (AD 335 – 375):

- The Gupta kingdom was enlarged enormously by Chandragupta's son & successor Samudragupta.
- Samudragupta believed in the policy of war & conquest & because of his bravery & generalship he is called the 'Napoleon' of India (by the historian V.A. Smith).

History of Chandragupta – II (AD 380 – 413):

- Samudragupta was succeeded by Ramgupta but Chandragupta II killed him & married his queen Dhruvadevi.
- He was the first ruler to issue silver coins. Also issued copper coins.
- His court was adorned by celebrated nine gems (navratnas) including Kalidasa, Amarsimha, Varahmihir, & Dhanvantri.
- Chinese pilgrim Fahien visited India at this time.

History of Kumaragupta – I (AD 413 – 455):

- He adopted the title of Mahendraditya.
- Founded Nalanda University (a renowned university of ancient India).
- He was the worshipper of Lord Kartikeya (son of Lord Shiva).
- In the last years of his reign, the peace & prosperity of the empire was disturbed due to the invasion of Turko-
- Mongol tribe, Hunas. During the war with the Hunas, Kumaragupta died.

History of Skandagupta (AD 455 – 467):

- Kumaragupta-I was followed by Skandagupta.
- Restored Sudarshana Lake.
- After his death, the great days of the Guptas were over. The empire continued but central control weakened, & local governors became feudatory kings with hereditary rights.

Gupta Literature in India:

- Kalidas, the great Sanskrit dramatist, belonged to this period. His books are: Abhigyanashakuntalam, (considered as one of the best literary works in the world & one of the earliest Indian work to be translated into European language, the other work being the Bhagavadgita), Ritusamhara, Meghadutam, Kumarasambhavam, Malavikagnimitram, Raghuvansha, Vikramurvashi etc. Out of these, Ritusamhara, Meghadutam, Raghuvansha were epics & the rest were plays.
- Vishakhadatta wrote Mudrarakshasa & Devichandraguptam
- Vishnu Sharma wrote Panchtantra & Hitopdesh
- The Gupta period also saw the development of Sanskrit grammar based on Panini & Patanjali
- Ramayana & Mahabharata were almost completed by the 4th century AD.

Other Dynasties & Rulers (7th Century–12th Century AD)

- **History of Harshavardhana (AD 606 – 647)**
- Belonged to Pushyabhuti family & son of Prabhakar Vardhan.
- Originally belonged to Thaneshwar, but shifted to Kannauj (after Harsha's death Kannauj was won from Harsha's successors by the Pratiharas).
- Chinese pilgrim, Hieun Tsang (Prince of Travelers) visited during his reign.
- Harsha himself wrote 3 plays – Priyadarshika, Ratnavali & Nagananda.
- After the death of Harsha in 647, the empire once again broke up into petty States.
  I – tsing, another Chinese pilgrim, visited in 670 AD.